

# County of Placer

Natural Community Conservation Plan

Habitat Conservation Plan

Phase One

Salmonid Spawning Habitat Surveys for Placer County Streams

March 24, 2004



# **Salmonid Spawning Habitat Surveys for Placer County Streams**

*Prepared for:*

Placer County Planning Department  
11414 B Avenue  
Auburn, CA 95603  
Contact: Melissa Batteate

*Prepared by:*

Jones & Stokes  
2600 V Street  
Sacramento, CA 95818-1914  
Contact: Warren Shaul and Donna Maniscalco  
916/737-3000

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# Introduction

The purpose of the salmonid spawning habitat surveys is to identify existing spawning habitat for salmonids in western Placer County streams based on the presence of suitable substrate that is accessible to anadromous fish. Gravel substrates are needed to support the spawning of steelhead, Chinook salmon, Pacific lamprey, and other species.

Fish biologists collected data on location, amount, and quality of suitable spawning substrate that is available to anadromous fish in western Placer County streams. Surveys were conducted August 5 through August 8, August 11 through August 15, and again on September 4, 5, and 10. Spawning gravel abundance and quality data were collected in stream habitat types expected to support spawning, including riffles, runs, and pool tail outs on Secret Ravine, Antelope Creek, Miner's Ravine, Doty Ravine, Coon Creek, and Auburn Ravine. The Bear River reach immediately downstream of the diversion dam that is accessible to the public was not surveyed because spawning habitat does not exist in this section. Miner's Ravine and Doty Ravine were surveyed for two separate sections, and Auburn Ravine was surveyed for three separate sections (see area map Figure 1). Biologists surveyed about 10.6 miles of stream channels.

## Methods

### Reach Identification

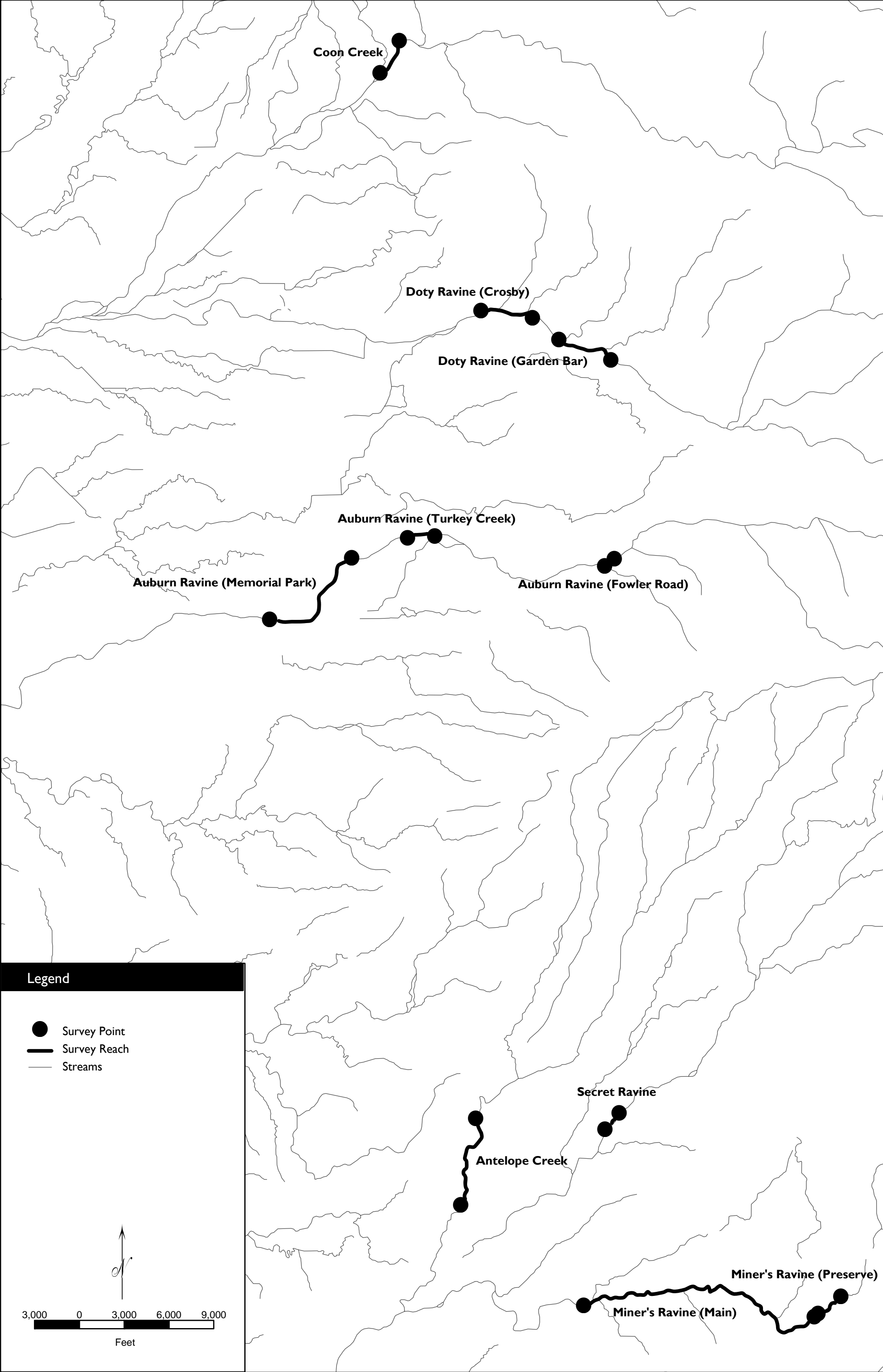
Potential spawning reaches were identified prior to conducting spawning habitat surveys. The initial assessment was based on conditions likely to support passage of adult salmonids, stream gradient, substrate, and historical spawning activity. The survey area was further narrowed based on available ingress to stream reaches. The Placer County Planning Department arranged access through private lands. All accessible potential spawning reaches (public and private) were marked on aerial photographs.

### Survey Methods

Methods are briefly described relative to measurement of stream flow, spawning gravel area, and spawning gravel quality. Detailed methods are described in Appendix A.

Stream flow was measured at the beginning of each day for each

Spawning Gravel Survey Reaches for Placer Legacy



surveyed reach. An area of uniform flow, such as a run or a pool tail out, was selected. A cross section perpendicular to the stream flow was established, and a measuring tape was secured across the width of the channel. Stream depth and flow velocity were measured along the cross section at intervals of 1 foot using a Marsh-McBirney Flo-Mate meter. A global positional system (GPS) reading was recorded near the center of the stream flow transect.

Spawning gravel surveys began at the downstream end of a stream reach. GPS locations of the start point and end point for each stream reach were recorded on the data collection form. Suitable spawning gravel patches having a minimum area of 10 square feet and at least 6 inches deep (depth refers to thickness of gravel layer) were identified. Gravels that were armored with cobbles or rock that measured more than 6 inches in any dimension were not considered as spawning habitat. Spawning gravel sizes range primarily from 0.25 to 4.0 inches in diameter. Although maximum usable gravel size depends on fish size, a number of studies have determined that Chinook salmon require gravel ranging from approximately 3 mm (0.1 inch) to 150 mm (5.9 inches) in diameter (Raleigh et al. 1986). Gravel substrates ranging from 25 mm (1 inch) to 102 mm (4 inches) provide a suitability index of 1 (Raleigh et al 1986). Steelhead prefer substrate no larger than 100 mm (3.9 inches) (Bjornn and Reiser 1991).

A GPS reading was recorded near the center of each gravel patch in the wetted stream channel. A location description was recorded on the data collection form under the "Comments/Location (Narrative)" column. The following alphanumeric naming convention was used to label each gravel patch: water year, 4-letter abbreviation for the stream (i.e., first 4 letters of the stream name), 4-letter abbreviation indicating the survey (i.e., GRAV), and a consecutive number for each gravel patch for the stream, beginning with 001. For example, the first gravel patch on Auburn Ravine for water year 2003 would be labeled 03-AUBU-GRAV-001.

The average length and width of the gravel patch were measured in feet and recorded on the data collection form. The percentage of gravel within each foot of contour elevation (elevation unit) was visually estimated. An elevation unit is used to determine the portion of a gravel patch potentially inundated during anadromous fish spawning periods. Elevation units are relative to the stream water surface and describe the elevation of the gravel in 1-foot increments. Negative numbers designate elevation units below the water surface, positive numbers designate elevation units above the water surface, and 0 is the water surface. For example, elevation unit -3 to -2 is between 2 and 3 feet below the water surface, and elevation unit 0 to +1 is between 0 and 1 foot above the water surface.

Gravel quality data indicate the proportion of fine sediments in spawning gravel. Steelhead and Chinook salmon require relatively clean gravel in which to spawn. Particle size has been defined as one of the main factors that affect embryo survival, time of emergence, and size of emergent fry (Bjornn and Reiser 1991). Silt and sand filling the gravel spaces (i.e., an increase in embeddedness) can reduce the flow of water and oxygen to eggs and larvae and reduce or prevent emergence of young fish after they have hatched. Relationships among particle size, permeability, intragravel flow, hydraulic gradients, and embryo survival are not fully understood. In general, a high percentage of fines decreases permeability and reduces flow velocity for a given pressure gradient. The rate of intragravel flow is related to, in addition to particle size, the permeability of the substrate, substrate compaction, and hydraulic pressure (Vyverberg et al. 1997). For this evaluation, fine sediment is defined as particles less than 2 mm (Category 1), which affects embryo survival, and less than 5 mm (Categories 1 and 2), which affects fry emergence. The threshold value where embryo survival is significantly reduced is fines exceeding 30% to 40% by volume (Raleigh et al 1986).

Gravel was removed from a 6-inch-diameter area in the deepest (thickest) part of the gravel patch. The gravel excavated from the hole was placed in a bucket. Gravel bed depth was estimated from the excavation. The gravel patch identification number was recorded on the data collection form. Excavated gravel was spread evenly over a tarp. A sampling grid was placed over the gravel that was spread on the tarp. The size of each particle that was located under each intersection of the grid lines was recorded by size category (Table 1). A tally of the number of particles in each size category was kept, and the total number of particles within each size category was summed. At least 84 particle measurements were recorded. The gravel sample was photographed and the photograph number recorded on the data collection form. See Appendix B for raw data sheets.

**Table 1.** Numeric Categories of Substrate Particle Size for Steelhead and Chinook Salmon Spawning Habitat

Particle Size		Category
Inches	Millimeters	
<0.08	<2	1
0.08–0.2	2–5	2
0.3–1.0	5–25	3
1.1–4.0	25–102	4
4.1–6.0	102–152	5
Modified from Crouse et al. 1981.		

## Results

Approximately 10.6 miles of stream channels were surveyed (Table 2). The majority of streams were surveyed in August. Auburn Ravine was not surveyed until September after flow was reduced to approximately 24 cfs. See Appendix C for patch-specific gravel data.

**Table 2.** Length and Flow for Each Stream Reach Surveyed

Date	Stream Name (Reach Name)	Approximate Reach Length (Miles)	Flow (cfs)
August 5, 2003	Secret Ravine	0.94	18
August 6, 2003	Antelope Creek	1.13	14
August 6, 2003	Miner's Ravine (Preserve property)	0.50	19
August 7-8, 2003	Miner's Ravine (Main)	2.50	41
August 11, 2003	Doty Ravine (Garden Bar Rd.)	0.50	22
August 14, 2003	Coon Creek	0.85	58
August 15, 2003	Doty Ravine (Crosby Harold Rd.)	0.93	23
September 4–5, 2003	Auburn Ravine (Memorial Park)	1.89	24
September 10, 2003	Auburn Ravine (Turkey Creek)	0.83	24
September 10, 2003	Auburn Ravine (Fowler Rd.)	0.50	24

## Gravel Abundance

There were four potential spawning sites within the 0.95 mile surveyed in Secret Ravine. The bed length ranged from 7.5 to 48.2 feet, and the

width ranged from 8.2 to 11.6 feet. All of the gravel was in the -1 to +1 foot elevation. The total area for the four sites was 1,176 square feet (Table 3). Gravel patches were found toward the downstream end of the surveyed reach. The substrate was sandier at the upstream end of the surveyed reach.

One potential spawning site was identified in 1.13 miles surveyed in Antelope Creek. The bed length was 16.5 feet, and the width was 12.9 feet, an area of 213 square feet (Table 3). The gravel was in the -1 foot to +2 feet elevation. The majority of the substrate in this creek is sand with interspersed cobble.

Miner's Ravine Preserve property was approximately 0.5 mile in length. Two potential spawning sites were identified with lengths of 21.1 feet and 45.5 feet, and widths of 9.3 feet and 7.0 feet. The total spawning habitat area was 515 square feet (Table 3). All gravel was from -1 to +1 foot in elevation. The gravel site width was narrow, but the gravel quality was good and the sites were included as spawning habitat.

The main segment surveyed in Miner's Ravine was located west of the Preserve property, and was approximately 2.5 miles long. One potential spawning site was 12 feet in length and 9 feet in width. All the gravel was from -1 to -2 feet in elevation. The total area was 108 square feet (Table 3). This was the only site that met the spawning habitat criteria and was included in the sampling. It is located close to the beginning of the reach surveyed. Ponded water and thick aquatic vegetation occurred over much of the reach.

The reach surveyed in Doty Ravine at Garden Bar Road (east of Crosby) was approximately 0.5 mile long. "No Trespassing" signs posted in the creek prevented a complete survey of the reach. Three potential spawning sites were identified and ranged in length from 12 to 42 feet, with widths from 7 to 11 feet. All gravel was in the -1 to +1 foot elevation unit. Total area was 833 square feet (Table 3).

The reach surveyed in Doty Ravine at Crosby Harold Road (west of Garden Bar Road.) was approximately 0.93 mile in length. Two potential spawning sites were identified with lengths of 39.5 feet and 89.2 feet and widths of 20.5 feet and 15.0 feet. All gravel was in the -2 feet to +1 foot elevation unit. Total area was 2,148 square feet (Table 3).

The reach surveyed in Coon Creek was approximately 0.85 mile long. One potential spawning site was identified, with a length of 71 feet and a width of 6 feet. All of the gravel was from 0 to -1 foot in elevation. Total area was 426 square feet (Table 3).

The first reach surveyed in Auburn Ravine from Memorial Park was 1.89 miles long. The 23 potential spawning sites ranged from 27 to 217 feet in length and from 21 to 37 feet in width. Gravel elevation ranged from

–3 feet to +3 feet. Total area was 55,424 square feet (Table 3). The second reach surveyed was east of Memorial Park at Turkey Creek golf course, and was approximately 0.83 mile long. There were nine potential spawning sites ranging from 29 to 177 feet long and from 25 to 42 feet wide. All gravel was in the –3 to +2 feet elevation unit. Total area for gravel sites was 21,153 square feet (Table 3). The third reach surveyed was at Fowler Road east of Turkey Creek, and was approximately 0.5 mile long. Four potential spawning gravel sites were identified, ranging from 56 to 117 feet long and from 27 to 44 feet wide. All gravel was in the –3 to +2 feet elevation unit. Total area of spawning gravel was 12,651 square feet (Table 3).

For those sites sampled, Auburn Ravine has more area of potential spawning habitat than all other stream reaches combined (Table 3). The total area for all streams was 94,647 square feet. Auburn Ravine has 89,228 square feet, accounting for 94.3% of all potential spawning habitat surveyed. Doty Ravine had the second highest area, totaling 2,981 square feet and accounting for 3.1% of potential spawning habitat. The other four streams account for 2.6% of surveyed spawning habitat. Most of the reaches were narrow and did not provide the width needed to meet the minimum spawning habitat criteria. The most complex habitat (i.e. hydrodynamics) and widest reaches were the Auburn Ravine sites. Coon Creek also had complex habitats with relatively wide riffles, pools, and runs.

## Gravel Quality

Gravel in most stream reaches was angular and not round. In Doty Ravine (Garden Bar Road) gravel particles were square and flat. All surveyed reaches had some amount of fine sediment (Table 4). Auburn Ravine had the least amount of fine particles. The percentage of particles in each size category was identified for 50 potential spawning sites (Table 4). Particles in category 1 (<2 mm) were observed at all sites, and percentages ranged from 2% to 66%. The percentages ranged from 13% to 77% for category 2 (2–5 mm), 7% to 58% for category 3 (5–25 mm), and 1% to 30% for category 4 (25–102 mm). Only four sites had large particles classified in category 5 (102–152 mm), and percentages ranged from 1% to 6%.

## Barriers

Barriers were apparent in most of the reaches surveyed. Most of the barriers were well-established beaver dams, anywhere from 2 to 4 feet high and about 2 feet wide across the top. For those areas surveyed, Secret Ravine, Antelope Creek, and Miner's Ravine (main) had the most beaver dams. Miner's Ravine had seven beaver dams in the reach surveyed. The dams created relatively deep pools and supported thick

aquatic vegetation. Doty Ravine (Crosby Harold) had a beaver dam at the beginning of the reach and another ¼ mile above the start point. Auburn Ravine at Turkey Creek had a large tree across the creek and woody material held up behind it. The dams and debris are migration barriers under low flow conditions.

**Table 3.** Total Spawning Habitat Area by Stream Reach Surveyed, and the Potential Number of Redds Supported in Each Reach

Stream Reach	Spawning Habitat Area (Square Feet)	Number of Potential Redds	
		Steelhead	Chinook Salmon
Secret Ravine	1,176	21	12
Antelope Creek	213	4	2
Miner's Ravine (Preserve)	515	9	5
Miner's Ravine (Main)	108	2	1
Doty Ravine (Garden Bar)	833	15	8
Doty Ravine (Crosby)	2,148	38	22
Coon Creek	426	8	4
Auburn Ravine (Memorial)	55,424	990	554
Auburn Ravine (Turkey Creek)	21,153	378	212
Auburn Ravine (Fowler)	12,651	226	127
Totals	94,647	1,691	947

**Table 4.** Percentage of Substrate in Each Particle Size Category for Each Gravel Site

Creek	Site Number	Category 1 (<2mm)	Category 2 (2–5mm)	Category 3 (5–25mm)	Category 4 (25–102mm)	Category 5 (102–152mm)
Secret Ravine	03-SECR-GRAV-001	52%	30%	13%	4%	0%
	03-SECR-GRAV-002	26%	25%	13%	30%	6%
	03-SECR-GRAV-003	47%	21%	15%	17%	0%
	03-SECR-GRAV-004	56%	22%	9%	14%	0%
Antelope Creek	03-ANTE-GRAV-001	49%	28%	14%	3%	5%
Miner's Ravine (Preserve)	03-MRNP-GRAV-001	42%	27%	27%	4%	0%
	03-MRNP-GRAV-002	48%	27%	22%	3%	0%
Miner's Ravine (Main)	03-MINEM-GRAV-001	32%	18%	34%	16%	0%
Doty Ravine (Garden)	03-DOTY-GRAV-001	38%	20%	31%	11%	0%
	03-DOTY-GRAV-002	36%	29%	34%	1%	0%
	03-DOTY-GRAV-003	20%	33%	45%	3%	0%
Coon Creek	03-COON-GRAV-001	24%	32%	37%	7%	0%
Doty Ravine (Crosby)	03-DOTC-GRAV-001	40%	24%	16%	20%	0%

Creek	Site Number	Category 1 (<2mm)	Category 2 (2–5mm)	Category 3 (5–25mm)	Category 4 (25–102mm)	Category 5 (102–152mm)
Auburn Ravine (Memorial)	03-DOTC-GRAV-002	44%	31%	25%	0%	0%
	03-AUB1-GRAV-001	61%	19%	18%	2%	0%
	03-AUB1-GRAV-002	59%	13%	17%	10%	0%
	03-AUB1-GRAV-003	39%	40%	17%	3%	0%
	03-AUB1-GRAV-004	32%	15%	24%	29%	0%
	03-AUB1-GRAV-005	47%	25%	22%	6%	0%
	03-AUB1-GRAV-006	35%	28%	29%	8%	0%
	03-AUB1-GRAV-007	33%	25%	27%	14%	0%
	03-AUB1-GRAV-008	33%	22%	32%	13%	0%
	03-AUB1-GRAV-009	34%	15%	22%	29%	0%
	03-AUB1-GRAV-010	31%	21%	30%	17%	0%
	03-AUB1-GRAV-011	48%	28%	11%	12%	0%
	03-AUB1-GRAV-012	30%	24%	18%	29%	0%
	03-AUB1-GRAV-013	56%	19%	16%	9%	0%
	03-AUB1-GRAV-014	47%	19%	19%	15%	0%
	03-AUB1-GRAV-015	24%	22%	31%	23%	0%
	03-AUB1-GRAV-016	12%	33%	40%	14%	0%
	03-AUB1-GRAV-017	66%	24%	7%	3%	0%
	03-AUB1-GRAV-018	9%	22%	40%	29%	0%
	03-AUB1-GRAV-019	2%	26%	58%	14%	0%
	03-AUB1-GRAV-020	18%	40%	25%	17%	0%
	03-AUB1-GRAV-021	8%	30%	43%	19%	0%
	03-AUB1-GRAV-022	8%	45%	27%	20%	0%
	03-AUB1-GRAV-023	19%	45%	16%	20%	0%
Auburn Ravine (Turkey Cr.)	03-AUBT-GRAV-001	2%	40%	40%	18%	0%
	03-AUBT-GRAV-002	4%	77%	15%	4%	0%
	03-AUBT-GRAV-003	7%	40%	35%	18%	0%
	03-AUBT-GRAV-004	36%	38%	23%	3%	0%
	03-AUBT-GRAV-005	43%	29%	12%	16%	0%
	03-AUBT-GRAV-006	17%	40%	24%	18%	0%
	03-AUBT-GRAV-007	21%	47%	20%	12%	0%
	03-AUBT-GRAV-008	5%	36%	42%	17%	0%
	03-AUBT-GRAV-009	32%	30%	26%	11%	1%
Auburn Ravine (Fowler Rd.)	03-AUBF-GRAV-001	6%	40%	38%	17%	0%
	03-AUBF-GRAV-002	7%	30%	34%	30%	0%
	03-AUBF-GRAV-003	8%	55%	19%	16%	2%
	03-AUBF-GRAV-004	3%	50%	23%	23%	0%

## Discussion

Observed redd size for Central Valley Chinook salmon ranges from 75 square feet to 650 square feet (Reynolds et al. 1990). Steelhead redds are substantially smaller. For the purpose of this discussion, a redd size of 56 square feet is assumed for steelhead and 100 square feet is assumed for Chinook salmon. Many of the measured gravel patches fell below the criteria of 56 and 100 square feet, so total square footage per reach surveyed was used to calculate the estimated number of redds. The total gravel area calculated for each reach was divided by 56 square feet to provide an estimated number of redds for steelhead and by 100 square feet to provide an estimated number of redds for Chinook salmon. The number of redds supported varied depending on species and reach (Table 3). The surveyed reaches in Auburn Ravine supported the most redds.

Redd numbers may be underestimated because spawning habitat was not surveyed throughout all potential spawning reaches that may be accessible to adult Chinook salmon and steelhead. Also, some spawning habitat did not meet the length and width criteria for the spawning gravel assessment. These smaller gravel patches could be used by Chinook salmon and steelhead for spawning. The length of potential spawning reaches was estimated for all streams (Table 5). The surveyed proportion of potential spawning habitat ranges from 9.8% (i.e., Secret Ravine) to 60% (i.e., Miner's Ravine). Based on the ratio of surveyed to potential spawning reaches, substantially more spawning habitat may be available.

**Table 5.** Comparison of Surveyed Reaches to Potential Spawning Reaches

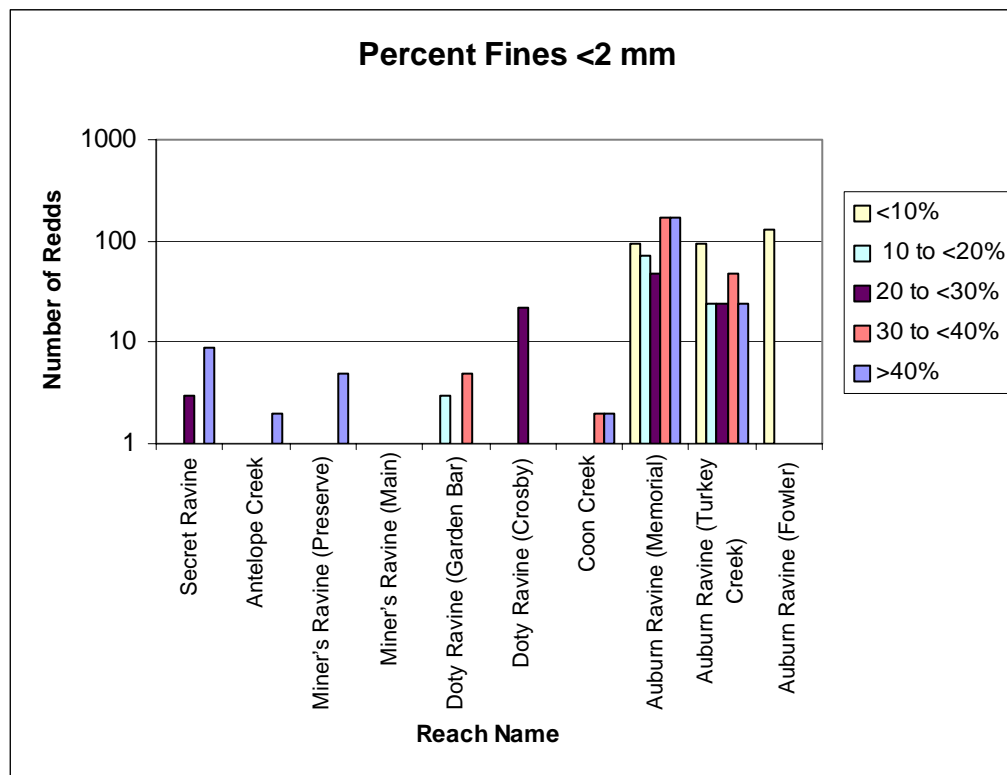
Stream Name (Reach Name)	Actual Surveyed Reaches (Miles)	Potential Spawning Reaches (Miles)	Potential Spawning Habitat Surveyed (%)
Secret Ravine	0.94	9.54	9.8
Antelope Creek	1.13	4.55	25
Miner's Ravine (Preserve property)	0.5	5.00	60 <sup>a</sup>
Miner's Ravine (Main)	2.5	-	-
Doty Ravine (Garden Bar Rd.)	0.5	6.00	16 <sup>a</sup>
Doty Ravine (Crosby Harold Rd.)	0.93	-	-
Coon Creek	0.85	6.81	12
Auburn Ravine (Memorial Park)	1.89	8.33	39 <sup>a</sup>
Auburn Ravine (Turkey Creek)	0.83	-	-
Auburn Ravine (Fowler Rd.)	0.5	-	-

<sup>a</sup> If more than one reach was surveyed for a stream, the surveyed lengths were added and then divided by the length of the potential spawning reach to calculate the percentage of potential spawning habitat surveyed.

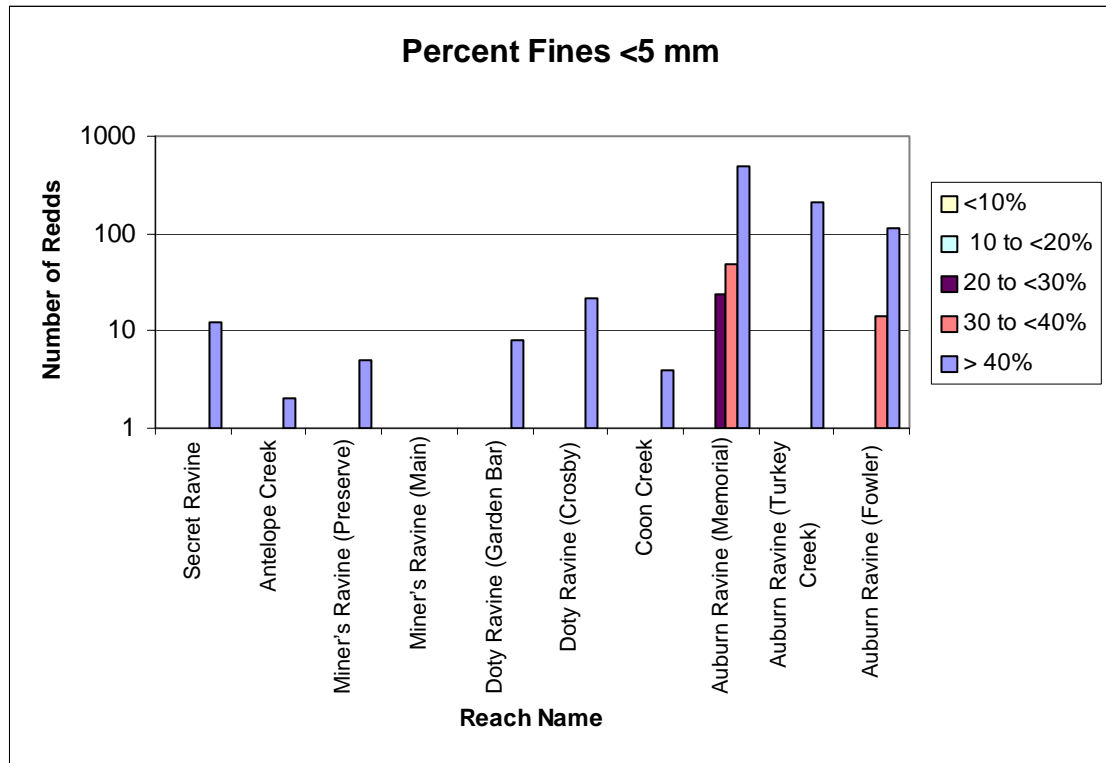
Antelope Creek had a mostly sandy bottom throughout the area surveyed and one potential spawning gravel site in 1.13 miles. Based on available data from the Dry Creek Watershed Coordinated Research Management Plan (2003) and this survey, Antelope Creek has highly degraded salmonid habitat and is unlikely to support substantial spawning habitat. Secret Ravine, Miner's Ravine, Doty Ravine, Coon Creek, and Auburn Ravine may have more spawning habitat within the reaches that were not surveyed. The occurrence of gravel increases at the downstream end of the reaches surveyed in Secret, Miners, and Doty Ravines, which may indicate that gravel is not available in the upstream reaches. Given its width and gravel abundance in the areas surveyed, Auburn Ravine has the most potential spawning habitat area.

Although substantially more spawning gravel may be present in the stream reaches that were not surveyed, the relatively high percentage of fine sediment in all reaches surveyed indicates potentially low availability of productive spawning habitat. The high percentage of fines within all stream reaches surveyed could result in low survival of eggs and emergent fry. The percentage of fines is one of the main factors that affects embryo survival, time of emergence, and size of emergent fry (Bjornn and Reiser 1991). Embryo survival is significantly reduced when the percentage of fines exceeds 30% to 40%. Fines reduce the supply of oxygen to the embryos and impede emergence of fry from redds (Tappel and Bjornn 1983, Waters 1995). Particles less than 2mm reduce the supply of oxygen and impede emergence. Particles between 2 mm and 5 mm have less effect on flow through a redd and oxygen supply, but may impede emergence. With the exception of Auburn Ravine, the percentage of fine particles less than 2 mm in diameter is relatively high (>20 %) for all locations (Figure 2). For those areas surveyed, Auburn Ravine has sufficient gravel for a substantial number of redds with <20% fines, indicating potential support of steelhead and Chinook salmon spawning and incubation. If fines <5mm are also considered, redds with less than 20% fines do not occur in any stream and redds with <30% fines are limited to Auburn Ravine (Figure 3). The high level of fines less than 2 mm and 5 mm indicates potentially poor spawning habitat and possibly low production of fry.

**Figure 2.** The Estimated Number of Chinook Salmon Redds by Percentage of Fines (i.e., <2 mm) for Stream Reaches Surveyed



**Figure 3.** The Estimated Number of Chinook Salmon Redds for Stream Reaches Surveyed by Percentage of Fines (i.e., <5 mm)



## Recommendations

Based on those stream reaches surveyed, the percentage of fine particles in spawning gravel is potentially a significant factor affecting production of Chinook salmon and steelhead fry in Placer County streams.

However, it is currently somewhat uncertain whether or not fines are a limiting factor for Chinook salmon and steelhead production.

Monitoring of fry emergence would provide information on the survival of eggs and young in the gravel. The purpose of the monitoring is to confirm that the fines are relevant to the protection and restoration of steelhead and Chinook salmon spawning habitat. Monitoring would provide data on emergence of fry from redds in Placer County streams.

The data could be used to identify relationships between emergence and environmental conditions, such as water temperature, channel dimensions and form, water depth and velocity, and substrate quality and scour. Based on the legal status of steelhead, monitoring could focus on Chinook salmon redds. Data collected for Chinook salmon can be applied to steelhead and general conclusions can be drawn for both

species. The data will help identify and confirm environmental conditions that may be limiting Chinook salmon and steelhead production, abundance, and distribution in Placer County streams. Actions may be identified and recommended to enhance spawning habitat conditions and contribute to the production of the life stage.

Another unknown factor is the source of fines. Fines present in all the stream reaches surveyed may be part of the natural bedload or the result of land use activities upstream. If fines are caused by human-related activities such as agriculture, construction, or other land use activities, measures can be taken to reduce erosion and fine deposition into the streams. If fines are part of the natural bedload, management actions are less feasible. Further investigation is required to determine the source of fines observed in the spawning gravel in Placer County streams.

Barriers to adult passage may be a seasonal or drought-related problem in some reaches and dependent on flow conditions or channel dimensions. Almost all reaches have beaver dams and some human-made barriers such as culverts and diversion dams. If the flow is high, most of the beaver dams would be passable. However, where numerous beaver dams are well established, such as in Miner's Ravine, extensive deep pool habitats have formed behind the dams. Spawning habitat is absent in the pools. Surveys of adult Chinook salmon and steelhead occurrence may be warranted to determine the accessibility to spawning reaches. Surveys of potential barriers (e.g., depth, velocity, and vertical drops) under variable flow conditions could also indicate passage conditions and the accessibility to spawning reaches.

The addition of spawning gravel to Placer County streams could increase spawning habitat area, but gravel augmentation is not recommended prior to better understanding of the factors potentially limiting production of fry that were discussed above (i.e., effects and source of fines, adult passage). Stream reaches are narrow and high flows may transport spawning gravel downstream and out of the spawning habitat reaches. Fine sediment may also be mobilized and deposited in the gravel, minimizing additional production benefits. At this time, Auburn Ravine is the most likely stream to benefit from gravel augmentation because the level of fines is lower than in other streams and the channel is much wider. The wider channel may help distribute and retain spawning gravel, although the retention of gravel and development of spawning habitat would need to be determined through detailed investigations by a geomorphologist.

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## Appendix A

# Methods

# Appendix A. Salmonid Spawning Habitat Survey Methods

## 1.0 Methods

### 1.1 Purpose and Objectives

The purpose of the salmonid spawning habitat surveys is to identify existing spawning habitat for salmonids in western Placer County streams based on the presence of suitable substrate that is accessible to anadromous fish for spawning. Suitable spawning habitat consists of rounded river gravel in patches at least 3 feet in diameter and 0.5 foot deep. Gravel substrates are needed to support the spawning of steelhead, Chinook salmon, Pacific lamprey, and other species.

Spawning habitat surveys will collect data on the location, amount, and quality of suitable substrate that is available to anadromous fish for spawning.

### 1.2 List of Equipment

In addition to basic field equipment, the field team will need the following specialized equipment:

- aerial photographs covering Bear River, Coon Creek, Doty Ravine, Markham Ravine, Auburn Ravine, Pleasant Grove Creek, Antelope Creek, Secret Ravine, and Miners Ravine Creek;
- global position system (GPS) receiver with 5-meter accuracy;
- depth rod (at least 4 feet long with divisions to 0.1 foot, preferably a top-setting rod);
- electronic flow meter;
- Ruler in metric units (to assist in estimating gravel size);
- 100-foot measuring tape;
- plastic bucket (12-inch diameter);
- shovel (can be small, collapsible style);
- sampling grid (a clear plastic sheet with 9 squares in each row and each column that forms eighty-one 5-centimeter squares and has lines intersecting at 100 points),
- high-resolution digital camera,
- dark-colored tarp (for spreading out gravel samples),
- hip or chest waders;
- wading staff (for stability and identifying deep water); and
- spawning gravel abundance and quality data collection forms.

### 1.3 Schedule

Salmonid spawning habitat surveys will be conducted once in July 2003 and will identify and quantify substrate suitable for anadromous fish spawning. In addition, gravel quality will be measured at all spawning gravel patches. Spawning gravel quality will be measured simultaneously with spawning gravel abundance measurements.

### 1.4 Location and Access

Spawning gravel abundance and quality data will be collected in stream habitat-types expected to support spawning, including riffles, runs, and pool tail outs on Bear River, Coon Creek, Doty Ravine, Markham Ravine, Auburn Ravine, Pleasant Grove Creek, Antelope Creek, Secret Ravine, and Miners Ravine Creek. Stream reaches to be surveyed will be identified in the office based on a review of available data including: stream flow and channel dimension, water temperature, stream gradient, substrate information, previous documented spawning locations, and other factors. The number of stream miles surveyed will also be dependent on access, especially access to stream reaches on private lands.

### 1.5 Spawning Gravel Abundance

#### 1.5.1 Field Methods

Below is a list that *summarizes* key field methods that the survey team will perform to measure spawning gravel abundance. These steps are described in detail below.

To measure spawning gravel abundance, the field team will

- identify suitable spawning gravel patches,
- visually estimate the elevation of a gravel patch relative to the water surface elevation,
- measure the length and width of the spawning gravel patch,
- measure gravel patch depth at selected locations,
- measure gravel size at selected locations,
- record GPS location of each gravel patch and mark the location on the aerial photographs,
- record gravel abundance data on appropriate data collection forms, and
- estimate stream flow based on field measurement of stream width, depth, and velocity.

### **1.5.2 In the Office**

1. Identify reaches to be surveyed based on adult salmonid access, stream gradient, substrate, historic spawning activity, and other factors.
2. Delineate the reaches that may support spawning habitat.
3. Obtain information on access to private lands from the Placer County Planning Department.
4. Mark the location of stream segments to be surveyed on the aerial photographs based on a review of all of the above information.

### **1.5.3 In the Field**

5. Begin at the downstream end of the stream segment to be surveyed.
6. Indicate the geographic location of the start point and end point for each stream segment on the data collection form.
7. Measure stream flow once each day for each stream surveyed on that day.
  - a. Select an area of uniform flow, such as a run or a pool tail out, but not a pool or riffle. Ideally, the cross section will not have large rocks, logs, or other obstacles, and the depth rod will not sink into soft substrate. Establish a cross section perpendicular to the stream flow, with the 0 placed at the left water's edge. The cross section should span the total wetted channel width.
  - b. Secure the measuring tape across the width of the channel using the chaining pins.
  - c. Measure stream depth and flow velocity along the cross section at intervals of 1 foot if the wetted channel width is greater than or equal to 25 feet or at intervals of 6 inches to 1 foot if the wetted channel width is less than 25 feet. There should be at least 25–30 intervals per cross section. If the intervals are not evenly spaced, the greater spacing should occur in the slower moving water.
  - d. Measure the depth, using a depth rod with attached velocity meter, at each interval of the cross section. Depth measurements should be recorded (in feet) to the nearest 0.1 foot on the data collection form.
  - e. If depth is less than or equal to 2.5 feet, measure velocity at 0.6 of the stream depth: multiply the depth in inches by 0.6 and hold the meter that many inches from the stream bottom. Use of a top-setting wading rod will allow placement of the velocity sensor at the correct position without needing to calculate the appropriate depth. Follow the manufacturer's directions for operating the velocity meter and the top-setting wading rod. Velocity measurements should be recorded to the nearest 0.1 foot per second on the data collection form.

- f. If depth is greater than 2.5 feet, measure velocity at 0.2 and 0.8 of the stream depth, and record both velocity measurements on the data collection form.

*Note: The velocity meter instructions should be read to determine if alternative locations of the velocity readings are suggested for the particular meter being used.*

- g. When feasible, take a GPS reading near the center of the stream flow transect in the wetted stream channel and record the stream flow transect on the appropriate aerial photograph. Record the GPS identification number for the stream flow transect on the stream flow measurement data collection form.
8. Identify suitable spawning gravel patches to be measured. Suitable spawning gravel patches
    - have a minimum area of 10 square feet and are at least 6 inches deep (depth refers to thickness of gravel layer),
    - are not armored with cobbles or rocks greater than 6 inches in any dimension, and
    - contain gravel sizes ranging primarily from 0.25 to 4.0 inches in diameter.
  9. When feasible, take a GPS reading near the center of the gravel patch in the wetted stream channel. Record the GPS identification number for the gravel patch on the spawning gravel abundance data collection form.
  10. Record the location of the gravel patch on the aerial photographs, and provide a location description on the data collection form under "Comments/Location (Narrative)" column.
  11. Use the following alphanumeric naming convention to label each gravel patch: water year, 4-letter abbreviation for the stream (i.e., first 4 letters of the stream name), 4-letter abbreviation indicating the survey (i.e., GRAV), and a consecutive number for each gravel patch for the stream, beginning with 001. For example, the first gravel patch on Auburn Ravine for water year 2003 would be labeled 03-AUBU-GRAV-001.
  12. Visually estimate the percentage of gravel within each foot of contour elevation (elevation unit) (figure 1).

*Note: An elevation unit is used to determine the portion of a gravel patch potentially inundated during anadromous fish spawning periods.*

- a. Establish a cross section by stretching a measuring tape across the gravel patch. The cross section must generally encompass all elevations of the gravel patch.
- b. Measure the average length and width of the gravel patch in feet and record on the data collection form.

- c. Determine the lowest point of the cross section relative to the stream surface by walking along the cross section and measuring water depth at regular intervals with a depth rod.
  - d. Beginning at the lowest point along the cross section, visually estimate the percentage of gravel (to the nearest 5 percent) in each elevation unit (figure 1) and record on the data collection form. Elevation units are relative to the stream water surface and describe the elevation of the gravel in 1-foot increments. Negative numbers designate elevation units below the water surface, positive numbers designate elevation units above the water surface, and 0 is the water surface. For example, elevation unit -3 to -2 is between 2 and 3 feet below the water surface, and elevation unit 0 to +1 is between 0 and 1 foot above the water surface. The percentages in the elevation units are not cumulative, that is, they are not added to the percentage in the adjacent elevation unit.
13. Measure the depth (i.e., thickness) of the gravel patch.
- a. Dig a 6-inch diameter hole or larger in what appears to be the deepest (i.e., thickest) part of the gravel patch and place the gravel excavated from the hole in a bucket. The depth of the hole should be at least 6 inches or, if less, excavated to a point where the gravel becomes too embedded to remove. If the gravel sample is under water, the mouth of the bucket should be just downstream of the excavated hole to capture all material that may be mobilized by stream flow.
  - b. Measure the depth of the hole (gravel patch depth) to the nearest 0.1 foot and record on the data collection form.
- Note: Gravel excavated for this survey should be set aside for measurement of spawning gravel quality (section 1.6).*
14. Conduct the spawning gravel quality assessment described in the following section (section 1.6).
15. Repeat for all gravel patches.

## 1.6 Spawning Gravel Quality

Spawning gravel quality represents the size and embeddedness of gravel particles. Embeddedness is the degree to which large particles (i.e., gravel and cobbles) are surrounded and/or covered by fine sediment (i.e., sand, silt, and clay). The purpose of collecting gravel quality data is to determine the proportion of fine sediments in existing spawning gravel. Steelhead and chinook salmon require relatively clean gravel in which to spawn. The filling of the smaller spaces between gravel particles with silt and sand (i.e., an increase in embeddedness) can reduce the flow of water and oxygen to eggs and larvae in the gravel and can reduce or prevent young fish from emerging after they have hatched.

### 1.6.1 Field Methods

Below is a list that *summarizes* key field methods that the survey team will perform to assess spawning gravel quality. These steps are described in detail below.

To measure spawning gravel quality, the field team will

- excavate samples at least 6 inches in diameter by 6 inches deep from suitable gravel patches identified during the spawning gravel abundance measurement,
- numerically categorize the gravel by quality category,
- photograph each quality sample, and
- record spawning gravel quality data on the appropriate data collection form.

### 1.6.2 In the Field

1. Assess spawning gravel quality using the material excavated for the spawning gravel abundance measurement.
2. Record the gravel patch identification number on the spawning gravel quality data collection form.
3. Spread the excavated gravel evenly over the tarp.
4. Photograph the gravel with a high-resolution digital camera (note: place the ruler in the frame to provide perspective), and record the digital image number on the data collection form.
5. Overlay the gravel that is spread on the tarp with the sampling grid.
6. On the data collection form, record the category for the size of each particle (table 1) that lies under each point of line intersection on the grid (figure 2). Keep a tally of the number of particles in each size category, then sum the total number of particles within each size category, and record the totals for each particle size category on the data collection form. Some of the line intersection points may be over areas on the tarp without gravel; the amount of gravel on the tarp should be sufficient to provide at least 85 particle measurements.
7. Backfill the excavated hole with the original material.
8. Repeat for gravel excavated from each gravel patch.

**Table 1.** Numeric Categories of Substrate Particle Size for Steelhead and Chinook Salmon Spawning Habitat

Particle Size		Category
Inches	Millimeters	
<0.08	<2	1
0.08–0.2	2–5	2
0.3–1.0	6–25	3
1.1–4.0	26–102	4
4.1–6.0	103–150	5
Modified from Crouse et al. 1981.		

### 1.6.3 In the Office

9. Download digital images from the digital camera.
10. Enter data into spreadsheets and, where appropriate, GIS.

## 1.6 References

Crouse, M.R., C.A. Callahan, K.W. Malueg, and S.E. Dominguez. 1981. Effects of fine sediments on growth of juvenile coho salmon in laboratory streams. Transactions of the American Fisheries Society 110:281-286

Appendix B

## **Original Data Sheets**

## Page 1 of 1

Notes on Upstream Changes in Flow  
(i.e., water observed entering or leaving the river): Faster  
water entering from u/s under bridge

WATER-04

Moved 6/3 to d15

# Spawning Gravel Abundance Data Collection Form FISH-02

Page 1 of 2

Date: 8/5/03

Measured Flow (cfs): \_\_\_\_\_

Monitoring Team Member Names: E. Routh, D. Maniscalco

Time Measured: 11:20

Stream Segment: Secret Ravine

Photo 1 - start point & looking towards flow measurement spot

Start Point for the Day: 38.56089 N 121.47713 West

End Point for the Day: 38.79175 N 121.21583 West

0.94 miles

38.79699N/121.20571 W (flow measurement point)

Gravel Bed Identification Number <sup>f</sup>	Gravel Bed Average Length (feet)	Gravel Bed Average Width (feet)	Percentage of Gravel Area in Each Elevation Unit <sup>g</sup>						Gravel Bed Depth (nearest 0.1 foot)	Location (Narrative)/GPS Identification Number/Comments
			-3 to -2 (feet)	-2 to -1 (feet)	-1 to 0 (feet)	0 to +1 (feet)	+1 to +2 (feet)	+2 to +3 (feet)		
03-SECR-GRAB-004	7.5'	8.2'			100				0.7'	Immediately below bridge/38.79728N, 121.47713W 38.79699N/121.20571W
03-SECR-GRAB-003	26.5'	9.5'			20	80			0.7'	38.79737N/121.20543W-middle of patch Above End point ~ 1/4 mile (Photo #3)
03-SECR-GRAB-002	48.2'	11.3'			90	10			0.7'	38.79535N/121.21162W (Photo #5) d/s of 2
03-SECR-GRAB-001	27.5'	11.6'			95	5			0.8'	38.79182N/121.21588W (Photo #7)

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> cfs=cubic feet per second.

<sup>f</sup> Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-GRAB-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be 03-AUBU-GRAB-001.

<sup>g</sup> Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

# Spawning Gravel Quality Data Collection Form FISH-03

Date: 8/5/03

Monitoring Team Member Names<sup>a</sup>: ETR D.M.

Stream Segment<sup>b</sup>: Secret Ravine

Start Point for the Day<sup>c</sup>: upstream boundary of Sierra College property, 5000 College Blvd

End Point for the Day<sup>d</sup>: Aguilera Rd (Corner near light) lg boulder w/ square marble on it.

Numeric Categories of Substrate Particle Size <sup>e</sup>	
Category	Average Size [millimeter (inches)]
1	<2 (<0.08)
2	2-5 (0.08-0.2)
3	5-25 (0.2-1)
4	25-102 (1-4)
5	102-152 (4-6)

Modified from Crouse et al. 1981.

Gravel Bed Identification Number <sup>e</sup>	Particle Size <sup>f</sup> (millimeters)					Comments/Ground-Level Digital Image Number
	Category 1 ≤2	Category 2 2-5	Category 3 5-25	Category 4 25-102	Category 5 102-150	
03-SECR- GRAV-004	Tally <sup>g</sup> 48	28	12	4	0	Mostly decomposed granite, photo #2
03-SECR- GRAV-003	Tally <sup>g</sup> 23	22	13	27	5	Lots of larger cobble, photo #4
03-SECR- GRAV-002	Tally <sup>g</sup> 40	18	13	15	0	Larger granite / cobble, photo #6
03-SECR- GRAV-001	Tally <sup>g</sup> 49	19	8	12	0	Lots of decomposed granite, photo #3

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> Use gravel bed identification number from the Spawning Gravel Abundance Data Collection Form FISH-02.

<sup>f</sup> Keep a tally for each category and then sum the totals.

<sup>g</sup> Total of particles within category.

<sup>h</sup> Particle size: see table at top right corner.

Page 1 of 1

Monitoring Team Member Names<sup>a</sup>: D. Mansueti  
E. Routh

General Description of Measurement Site  
(stream characteristics and location): Sandy bottomed  
creek @ end of Hunt Club Rd.

Notes on Upstream Changes in Flow  
(i.e., water observed entering or leaving the river): No

change in flow

Photo # 18

WATER-04

## Page 1 of 1

Time Measured: 9:00

(Pt. 11 O. 2 miles from Pt. 12)

(Pt. 11 O. 2 miles from Pt. 12)

1.13 miles

✓ Photo #14

Striking above sm. bridge in housing development. @ pipe that is v/s. (photo 11<sup>2</sup> #17)  
Stopped @ housing development on West side of creek. Farron Rd - X-Street - Whitney

Bank on East side / 38.77504N / 121.95322W (4.13)  
off of sandy beach Photo # 116  
38.77500 121.25325

- FISH-02

# Spawning Gravel Quality Data Collection Form FISH-03

Date: 8/6/03

Monitoring Team Member Names<sup>a</sup>: E. Routh, D. Maurice Deo

Stream Segment<sup>b</sup>: Antelope Creek

Start Point for the Day<sup>c</sup>: 38.77500 N 121.25523 W

End Point for the Day<sup>d</sup>: 38.79047 N 121.24950 W

Numeric Categories of Substrate Particle Size <sup>f</sup>	
Category	Average Size [millimeter (inches)]
1	<2 (<0.08)
2	2-5 (0.08-0.2)
3	5-25 (0.2-1)
4	25-102 (1-4)
5	102-152 (4-6)

Modified from Crouse et al. 1981.

Gravel Bed Identification Number <sup>e</sup>	Particle Size <sup>f</sup> (millimeters)					Comments/Ground-Level Digital Image Number
	Category 1 ≤2	Category 2 2-5	Category 3 5-25	Category 4 25-102	Category 5 102-150	
03-AMTE- GRAV-DD1	Tally <sup>g</sup>	47	27	13	3	Photo 15, 15+ of decomposed granite
	<del>Tally<sup>g</sup></del>					
	<del>Tally<sup>g</sup></del>					
	<del>Tally<sup>g</sup></del>					
	<del>Tally<sup>g</sup></del>					
	Tally <sup>g</sup>					
	<del>Tally<sup>g</sup></del>					
	<del>Tally<sup>g</sup></del>					
	<del>Tally<sup>g</sup></del>					
	<del>Tally<sup>g</sup></del>					

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> Use gravel bed identification number from the Spawning Gravel Abundance Data Collection Form FISH-02.

<sup>f</sup> Keep a tally for each category and then sum the totals.

<sup>g</sup> Total of particles within category.

<sup>h</sup> Particle size: see table at top right corner.

Page 1 of 1ChangesWATER-04

# Spawning Gravel Abundance Data Collection Form FISH-02

Date: 8/6/03

Measured Flow (cfs): \_\_\_\_\_

Monitoring Team Member Names<sup>a</sup>: E. Routh, D. Mansueti

Time Measured: 2:14:30

Stream Segment<sup>b</sup>: Mine's Ravine (Reserve Prop.)

Start Point for the Day<sup>c</sup>: 38.75384 N / 121.17039 W

End Point for the Day<sup>d</sup>: 38.75755 N / 121.16406 W

Gravel Bed Identification Number <sup>e</sup>	Gravel Bed Average Length (feet)	Gravel Bed Average Width (feet)	Percentage of Gravel Area in Each Elevation Unit <sup>f</sup>					Gravel Bed Depth (nearest 0.1 foot)	Location (Narrative)/GPS Identification Number/Comments
			-3 to -2 (feet)	-2 to -1 (feet)	-1 to 0 (feet)	0 to +1 (feet)	+1 to +2 (feet)	+2 to +3 (feet)	
03-WRNP-GRAY-001	45.5'	7.0'			90	10			1500 start 38.75423N / 121.17030W (P.S.) Photo #11
03-WRNP-GRAY-002	21.1'	9.3'			99	1			Velocity higher in this area / 38.75439N / 121.16949W (A.6) Photo #10

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> cfs=cubic feet per second.

<sup>f</sup> Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-GRAY-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be 03-AUBU-GRAY-001.

<sup>g</sup> Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

# Spawning Gravel Quality Data Collection Form FISH-03

Date: 8/6/03

Monitoring Team Member Names: ETR DM

Stream Segment: Miners Ravine (Preserve Prop)

Start Point for the Day: 38.75384 N / 121.17039 W

End Point for the Day: 38.75755 N / 121.16106 W

Numeric Categories of Substrate Particle Size <sup>1</sup>	
Category	Average Size [millimeter (inches)]
1	<2 (<0.08)
2	2-5 (0.08-0.2)
3	5-25 (0.2-1)
4	25-102 (1-4)
5	102-152 (4-6)

Modified from Crouse et al. 1981.

Gravel Bed Identification Number <sup>c</sup>	Particle Size <sup>f</sup> (millimeters)					Comments/Ground-Level Digital Image Number
	Category 1 ≤2	Category 2 2-5	Category 3 5-25	Category 4 25-102	Category 5 102-150	
03-MRNP-GRV-001	Tally <sup>g</sup>					Much better than other sites to date, more gravel less decomposed granite, no water gravel photo # 12
	Sum <sup>h</sup>	38	24	4		
03-MRNP-GRV-002	Tally <sup>g</sup>					Not as good as last one but good overall, lots of larger gravel photo # 9
	Sum <sup>h</sup>	45	25	21	3	
	Tally <sup>g</sup>					
	Sum <sup>h</sup>					
	Tally <sup>g</sup>					
	Sum <sup>h</sup>					

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> Use gravel bed identification number from the Spawning Gravel Abundance Data Collection Form FISH-02.

<sup>f</sup> Keep a tally for each category and then sum the totals.

<sup>g</sup> Total of particles within category.

<sup>h</sup> Particle size: see table at top right corner.

## Page 1 of 1

### General Description of Measurement Site

(stream characteristics and location): Above bridge @  
turning Blvd. Width channel w/veg along  
edges

### Notes on Upstream Changes in Flow

(i.e., water observed entering or leaving the river): No

Change in flow either direction

photo #8

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>c</sup> The GPS receiver generates an identification number for each collected point. This identification number consists of the GPS receiver identification letter, date, Greenwich Mean Time (GMT), and a letter for multiple points collected within the hour. For example, the GPS identification number A103117C is defined as follows: "A" is the GPS receiver identification letter, "1031" is October 31, "17" is 5 p.m. GMT, and "C" indicates that this point was the third point taken within the 17<sup>th</sup> hour.

<sup>d</sup> The 0 should be at the left water's edge. Left is relative to a person facing downstream.

<sup>c</sup> If depth is greater than 2.5 feet, measure velocity at 0.2 and 0.8 of the total depth. Otherwise, measure velocity at 0.6 of the total depth.

# Spawning Gravel Abundance Data Collection Form FISH-02

Page 1 of 1  
Bike path along east side  
Bridge 1 @ Taylor + ?

Date: 7/10/03

Measured Flow (cfs):

Monitoring Team Member Names: E. Routh, D. Maus, R. L. D.

Time Measured: 10:25

Stream Segment: Miner's Ravine (Main) MINEM

Start Point for the Day: 38.75439N/121.16953W (Above bridge @ Standing Blvd.)

End Point for the Day: 38.75862N/121.24630 (at bridge off bike path)

\* Bridge 2 @ ?  
38.75727N/121.25843W (at 3)  
38.75554N  
38.76086N/121.25123W (at 2)  
2' high beaver dam above bridge 2  
(0.3 mi)

Stopped before Alexandra Dr  
w/new housing development on  
corner above white house  
(Roseville Pkwy. at Taylor + ?)

Gravel Bed Identification Number <sup>f</sup>	Gravel Bed Average Length (feet)	Gravel Bed Average Width (feet)	Percentage of Gravel Area in Each Elevation Unit <sup>g</sup>					Gravel Bed Depth (nearest 0.1 foot)	Location (Narrative)/GPS Identification Number/Comments
			-3 to -2 (feet)	-2 to -1 (feet)	-1 to 0 (feet)	0 to +1 (feet)	+1 to +2 (feet)	+2 to +3 (feet)	
03-MINEM-06-RAV-001	12'	9'		100					Underneath abutts, run-type habitat. Below store on east side / 38.75541N/121.26701W (p+2.)

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> cfs=cubic feet per second.

<sup>f</sup> Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-GRAB-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be 03-AUBU-GRAB-001.

<sup>g</sup> Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

\* N. Sunrise Ave + East Roseville Pkwy

# Spawning Gravel Quality Data Collection Form FISH-03

Date: 8/7/03

Monitoring Team Member Names<sup>a</sup>: ETR, DM.

Stream Segment<sup>b</sup>: Movers Run, Main (MINE-M)

Start Point for the Day<sup>c</sup>: Harding Blvd Bridge 38.75439N/121.16953W

End Point for the Day<sup>d</sup>: @ bike path bridge 38.75862N/121.24635W

## Numeric Categories of Substrate Particle Size<sup>e</sup>

Category	Average Size [millimeter (inches)]
1	<2 (<0.08)
2	2-5 (0.08-0.2)
3	5-25 (0.2-1)
4	25-102 (1-4)
5	102-152 (4-6)

Modified from Crouse et al. 1981.

Gravel Bed Identification Number <sup>e</sup>	Particle Size <sup>f</sup> (millimeters)					Comments/Ground-Level Digital Image Number
	Category 1 ≤2	Category 2 2-5	Category 3 5-25	Category 4 25-102	Category 5 102-150	
03-MINE-M GRAV-001	Tally <sup>g</sup>       Sum: 28	Tally <sup>g</sup>       Sum: 10	Tally <sup>g</sup>       Sum: 30	Tally <sup>g</sup>       Sum: 14	Tally <sup>g</sup>     Sum: 3	lots of good round gravel, fair amount of decomposed granite as well photo #5
	Tally <sup>g</sup>					
	Tally <sup>g</sup>					
	Tally <sup>g</sup>					
	Tally <sup>g</sup>					
	Tally <sup>g</sup>					
	Tally <sup>g</sup>					

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> Use gravel bed identification number from the Spawning Gravel Abundance Data Collection Form FISH-02.

<sup>f</sup> Keep a tally for each category and then sum the totals.

<sup>g</sup> Total of particles within category.

<sup>h</sup> Particle size: see table at top right corner.

Date: 8/8/03

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Measured Flow (cfs)<sup>e</sup>:

Monitoring Team Member Names: Dhanu calco, E Raut

Time Measured: Start @ 8:11

Stream Segment<sup>b</sup>: Miner's Ravine (Main-Day 2)

Stream Segment: 1 Upper 3 Riverine (Main Day 2)  
Start Point for the Day: 38.75850 N / 121.24675 W (Photo #4 - Aquatic Veg) - here, went around. Did not go in.

End Point for the Day<sup>d</sup>: 38.19678N / 121.92447W

(Sierra College Blvd) Photo #24-camera #2

(2.29 miles from  
start yesterday but  
probably 3+ mi.)

[illegible]

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> cfs=cubic feet per second.

Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-GRAV-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be 03-AUBU-GRAY-001.

Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

# Spawning Gravel Quality Data Collection Form FISH-03

Date: 8/8/03

Monitoring Team Member Names: D. Mansueti, E. Roubt

Stream Segment: Miner's Ruine (Main - Day 2)

Start Point for the Day: 38.75850 N / 121.24675 W

End Point for the Day: 38.75628 N / 121.22447 W

## Numeric Categories of Substrate Particle Size<sup>1</sup>

Category	Average Size [millimeter (inches)]
1	<2 (<0.08)
2	2-5 (0.08-0.2)
3	5-25 (0.2-1)
4	25-102 (1-4)
5	102-152 (4-6)

Modified from Crouse et al. 1981.

Gravel Bed Identification Number <sup>e</sup>	Particle Size <sup>f</sup> (millimeters)	Particle Size <sup>f</sup> (millimeters)					Comments/Ground-Level Digital Image Number
		Category 1 ≤2	Category 2 2-5	Category 3 5-25	Category 4 25-102	Category 5 102-150	
	Tally <sup>g</sup>						
	Sum <sup>h</sup>						
	Tally <sup>g</sup>						
	Sum <sup>h</sup>						
	Tally <sup>g</sup>						
	Sum <sup>h</sup>						
	Tally <sup>g</sup>						
	Sum <sup>h</sup>						

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> Use gravel bed identification number from the Spawning Gravel Abundance Data Collection Form FISH-02.

<sup>f</sup> Keep a tally for each category and then sum the totals.

<sup>g</sup> Total of particles within category.

<sup>h</sup> Particle size: see table at top right corner.

## Page 1 of 1

Current coming Culvert

WATER-04

# Spawning Gravel Abundance Data Collection Form FISH-02

Date: 8/11/03

Measured Flow (cfs):

Monitoring Team Member Names: ER, DM

Time Measured: 10:35

Stream Segment: Doty Ravine - Garden Bar

Start Point for the Day: 38.93312N/121.22837W (from car)

End Point for the Day:

Resting @ 38.93050N/121.21619W (1/5 end of go down)

Photo #14 - End pt from d/s to u/s end  
38.93312N/121.22465W (No spawning  
begin in creek)

Gravel Bed Identification Number <sup>f</sup>	Gravel Bed Average Length (feet)	Gravel Bed Average Width (feet)	Percentage of Gravel Area in Each Elevation Unit <sup>g</sup>						Gravel Bed Depth (nearest 0.1 foot)	Location (Narrative)/GPS Identification Number/Comments
			-3 to -2 (feet)	-2 to -1 (feet)	-1 to 0 (feet)	0 to +1 (feet)	+1 to +2 (feet)	+2 to +3 (feet)		
<del>03-DOT1-GRAY-001</del>	<del>12.0'</del>	<del>7.0'</del>			100				0.7'	<del>Resting u/s of culvert (immediately above)</del> <del>GPS unit + Pick up satellite here - Photo #14</del> <del>(38.93312N/121.22837W)</del> <del>Immediately d/s of culvert ~ 1/2 mile</del> <del>38.93354N/121.22837W - (water GPS signal)</del> <del>Photo #16 - Near IWM (water velocity water)</del> <del>38.93354N/121.22837W - (water GPS (22.5 ft below))</del>
03-DOT1-GRAY-002	42.0'	10.5'			95	5			0.8'	
03-DOT1-GRAY-003	28.0'	11.0'			100				0.9'	

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> cfs=cubic feet per second.

<sup>f</sup> Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-GRAY-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be 03-AUBU-GRAY-001.

<sup>g</sup> Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

# Spawning Gravel Quality Data Collection Form FISH-03

Date: 8/11/03

Monitoring Team Member Names<sup>1</sup>: ERoutt, D Mawacadeo

Stream Segment<sup>2</sup>: Dety Ravine - Garden Bar

Start Point for the Day<sup>3</sup>: 38934 39W/121.07837W

End Point for the Day<sup>4</sup>: 38.93050N/121.21619

Numeric Categories of Substrate Particle Size <sup>1</sup>	
Category	Average Size [millimeter (inches)]
1	<2 (<0.08)
2	2-5 (0.08-0.2)
3	5-25 (0.2-1)
4	25-102 (1-4)
5	102-152 (4-6)

Modified from Crouse et al. 1981.

Gravel Bed Identification Number <sup>5</sup>		Particle Size <sup>6</sup> (millimeters)					Comments/Ground-Level Digital Image Number
		Category 1 ≤2	Category 2 2-5	Category 3 5-25	Category 4 25-102	Category 5 102-150	
03-D014-001	Tally <sup>8</sup>						lots of square rocks, patch was a bit small photo # 80
	Sum <sup>9</sup>	35	19	21	10	0	
03-D014-002	Tally <sup>8</sup>						lots of square rocks, lots of decomposed gravel photo # 18
	Sum <sup>9</sup>	32	26	30	1	0	
03-D014-003	Tally <sup>8</sup>						square rocks, less decomposed gravel than before photo # 15
	Sum <sup>9</sup>	18	30	41	3	0	
	Tally <sup>8</sup>						
	Sum <sup>9</sup>						

<sup>1</sup> List first initial and last name of each member of the monitoring team.

<sup>2</sup> Indicate stream reach.

<sup>3</sup> Geographic location of start point for data entered on this form.

<sup>4</sup> Geographic location of end point for data entered on this form.

<sup>5</sup> Use gravel bed identification number from the Spawning Gravel Abundance Data Collection Form FISH-02.

<sup>6</sup> Keep a tally for each category and then sum the totals.

<sup>7</sup> Total of particles within category.

<sup>8</sup> Particle size: see table at top right corner.

# Stream Flow Measurements Data Collection Form WATER-01

Page 1 of 1

Date: 8/15/03

Monitoring Team Member Names<sup>a</sup>: D. Mansueto  
E. Routh

Stream Segment<sup>b</sup>: Doty Ravine - Crosby Hauld

GPS Identification Number<sup>c</sup>: 38.94018N/121.24486W

Channel Width: 31.5'

General Description of Measurement Site

(stream characteristics and location): Run type  
area below 1st property line where we  
entered creek

Notes on Upstream Changes in Flow

(i.e., water observed entering or leaving the river): Entering  
creek through incised channel, leaving  
through pooled area (Photos 22+23)

Tape Distance (feet) <sup>d</sup>	Depth (feet)	Velocity (feet per second) <sup>e</sup>			Comments
		0.2 * depth	0.8 * depth	0.6 * depth	
1.5	1.1			0.08	
3	1.1			0.28	
4.5	1.25			0.42	
6	1.4			0.50	
7.5	1.4			0.49	
9	1.3			0.44	
10.5	0.9			0.51	
12	0.9			0.46	
13.5	0.9			0.41	
15	0.9			0.21	
14.5	0.8			0.17	
18	0.65			0.10	
19.5	0.7			0.17	
21	0.6			0.19	
22.5	0.4			0.11	
24	0.1			0.02	probe not fully in water
27	0.2			0.12	
28.5	0.35			0.02	
30	0.45			0.00	

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> The GPS receiver generates an identification number for each collected point. This identification number consists of the GPS receiver identification letter, date, Greenwich Mean Time (GMT), and a letter for multiple points collected within the hour. For example, the GPS identification number A103117C is defined as follows: "A" is the GPS receiver identification letter, "1031" is October 31, "17" is 5 p.m. GMT, and "C" indicates that this point was the third point taken within the 17<sup>th</sup> hour.

<sup>d</sup> The 0 should be at the left water's edge. Left is relative to a person facing downstream.

<sup>e</sup> If depth is greater than 2.5 feet, measure velocity at 0.2 and 0.8 of the total depth. Otherwise, measure velocity at 0.6 of the total depth.

# Spawning Gravel Abundance Data Collection Form FISH-02

Date: 8/15/03

Measured Flow (cfs): \_\_\_\_\_

Monitoring Team Member Names: DM, ER

Time Measured: \_\_\_\_\_

Stream Segment: Doty Ravine - Crosby Blvd

Start Point for the Day: 38.93933N/121.24469W (Crosby Herald Rd bridge - very lg beaver dam)

End Point for the Day: 38.93840N/121.23460W

\*Beaver dam about 1/10 mi up stream

Gravel Bed Identification Number <sup>f</sup>	Gravel Bed Average Length (feet)	Gravel Bed Average Width (feet)	Percentage of Gravel Area in Each Elevation Unit <sup>g</sup>						Gravel Bed Depth (nearest 0.1 foot)	Location (Narrative)/GPS Identification Number/Comments
			-3 to -2 (feet)	-2 to -1 (feet)	-1 to 0 (feet)	0 to +1 (feet)	+1 to +2 (feet)	+2 to +3 (feet)		
03-DOTC-GRAN-001	89.2'	15.0'		20	40	40			0.6'	Channel narrows w/ high velocity water
03-DOTC-GRAN-002	39.5'	20.5'				100			0.5' - dig hole to test velocity water	38.93933N/121.24230W - Photo #21 *
										38.93840N/121.23460W Photo #19

- List first initial and last name of each member of the monitoring team.
- Indicate stream reach.
- Geographic location of start point for data entered on this form.
- Geographic location of end point for data entered on this form.
- cfs=cubic feet per second.
- Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-GRAN-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be -03-AUBU-GRAN-001.
- Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

# Spawning Gravel Quality Data Collection Form FISH-03

Date: 8/15/03

Monitoring Team Member Names<sup>1</sup>: E. Routh, D. Mawaradloo

Stream Segment<sup>2</sup>: Dolly Ravine @ Crosby Reservoir

Start Point for the Day<sup>3</sup>: 38.93963 N / 121.24669 W 0.93 mi total distance

End Point for the Day<sup>4</sup>: 38.93963 N / 121.24669 W (3893710N/121.23579W)

38.93890N/121.23460W

Modified from Crouse et al. 1981.

## Numeric Categories of Substrate Particle Size<sup>1</sup>

Category	Average Size [millimeter (inches)]
1	<2 (<0.08)
2	2-5 (0.08-0.2)
3	5-25 (0.2-1)
4	25-102 (1-4)
5	102-152 (4-6)

Gravel Bed Identification Number <sup>5</sup>		Particle Size <sup>6</sup> (millimeters)					Comments/Ground-Level Digital Image Number
		Category 1 ≤2	Category 2 2-5	Category 3 5-25	Category 4 25-102	Category 5 102-150	
03-DORC- GKAW-001	Tally <sup>8</sup>						lots of larger rocks, mud lots of decomposed granite photo #20
	Sum <sup>9</sup>	35	21	14	18	0	
	Tally <sup>8</sup>						
03-DORT- GR AV-002	Tally <sup>8</sup>						could not dig 6" deep, too many large rocks (decompositional) rocks are sparse lots of decomposed granite photo #18
	Sum <sup>9</sup>	38	27	22	0	0	
	Tally <sup>8</sup>						
	Sum <sup>9</sup>						
	Tally <sup>8</sup>						
	Sum <sup>9</sup>						

Two other gravel patches similar to above (~3)

- List first initial and last name of each member of the monitoring team.
- Indicate stream reach.
- Geographic location of start point for data entered on this form.
- Geographic location of end point for data entered on this form.
- Use gravel bed identification number from the Spawning Gravel Abundance Data Collection Form FISH-02.
- Keep a tally for each category and then sum the totals.
- Total of particles within category.
- Particle size: see table at top right corner.

Page 1 of 1

Notes on Upstream Changes in Flow  
(i.e., water observed entering or leaving the river). Ruffles  
above & below site (3)

WATER-04

# Spawning Gravel Abundance Data Collection Form FISH-02

Date: 8/14/03 Measured Flow (cfs): \_\_\_\_\_  
 Monitoring Team Member Names: E. Root, D. Mansueti  
 Stream Segment: Corn Creek Time Measured: 9:33  
 Start Point for the Day: 38.98379N/121.26996W  
 End Point for the Day: 38.98973N/121.26543W

Gravel Bed Identification Number <sup>f</sup>	Gravel Bed Average Length (feet)	Gravel Bed Average Width (feet)	Percentage of Gravel Area in Each Elevation Unit <sup>g</sup>					Gravel Bed Depth (nearest 0.1 foot)	Location (Narrative)/GPS Identification Number/Comments
			-3 to -2 (feet)	-2 to -1 (feet)	-1 to 0 (feet)	0 to +1 (feet)	+1 to +2 (feet)	+2 to +3 (feet)	
03-CON-001 CAW-	71.0'	6.0'			100				38.98513N/121.26838W - Photo #3 - fast moving channel off to side where access to creek is.

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> cfs=cubic feet per second.

<sup>f</sup> Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-Grav-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be 03-AUBU-Grav-001.

<sup>g</sup> Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

# Spawning Gravel Quality Data Collection Form FISH-03

Date: 8/14/03

Monitoring Team Member Names<sup>1</sup>: E. Routh, D. Marmorello

Stream Segment<sup>2</sup>: Coon Creek

Start Point for the Day<sup>3</sup>: 38.98379 N / 121.26996 W (Orange line going across creek)

End Point for the Day<sup>4</sup>: 38.98973 N / 121.26543 W (Barbwire fence in water - Photo #27 - Camera 3)

Numeric Categories of Substrate Particle Size <sup>1</sup>	
Category	Average Size [millimeter (inches)]
1	<2 (<0.08)
2	2-5 (0.08-0.2)
3	5-25 (0.2-1)
4	25-102 (1-4)
5	102-152 (4-6)

Modified from Crouse et al. 1981.

Gravel Bed Identification Number <sup>5</sup>	Particle Size <sup>6</sup> (millimeters)					Comments/Ground-Level Digital Image Number
	Category 1 ≤2	Category 2 2-5	Category 3 5-25	Category 4 25-102	Category 5 102-150	
03-COOL-GRAB-001	Tally <sup>8</sup>					Photo #1 - Camera 2 - Mostly square rocks, not a lot of decomposed granite
	Sum	22	29	33	6	
	Tally <sup>8</sup>					
	Sum					
	Tally <sup>8</sup>					
	Sum					
	Tally <sup>8</sup>					
	Sum					
	Tally <sup>8</sup>					
	Sum					

- List first initial and last name of each member of the monitoring team.
- Indicate stream reach.
- Geographic location of start point for data entered on this form.
- Geographic location of end point for data entered on this form.
- Use gravel bed identification number from the Spawning Gravel Abundance Data Collection Form FISH-02.
- Keep a tally for each category and then sum the totals.
- Total of particles within category.
- Particle size: see table at top right corner.

Notes on Upstream Changes in Flow  
(i.e., water observed entering or leaving the river): Slower  
above site, Channels down &  
faster below

WATER-04

# Spawning Gravel Abundance Data Collection Form FISH-02

Date: 9/10/03

Measured Flow (cfs): \_\_\_\_\_

Monitoring Team Member Names: KZ, DM

Time Measured: \_\_\_\_\_

Stream Segment: Auburn Ravine @ Turkey Creek

Start Point for the Day: 38.89806N/121.26437W

End Point for the Day: 38.89833N/121.25803W

Gravel Bed Identification Number <sup>1</sup>	Gravel Bed Average Length (feet)	Gravel Bed Average Width (feet)	Percentage of Gravel Area in Each Elevation Unit <sup>2</sup>						Gravel Bed Depth (nearest 0.1 foot)	Location (Narrative)/GPS Identification Number/Comments
			-3 to -2 (feet)	-2 to -1 (feet)	-1 to 0 (feet)	0 to +1 (feet)	+1 to +2 (feet)	+2 to +3 (feet)		
03-AUBT-GRN-001	177	29	3	6	45	45	1	0	1.0	38.89806N/121.26437W
03-AUBT-GRN-002	70	25	7	13	45	35	0	0	0.8	38.89857N/121.26319W <sup>d</sup>
03-AUBT-GRN-003	138	27	0	5	90	5	0	0	0.8	38.89838N/121.26176W <sup>d</sup>
03-AUBT-GRN-004	73	33	2	6	52	40	0	0	0.0	38.89851N/121.26054W <sup>d</sup>

<sup>1</sup> List first initial and last name of each member of the monitoring team.

<sup>2</sup> Indicate stream reach.

<sup>3</sup> Geographic location of start point for data entered on this form.

<sup>4</sup> Geographic location of end point for data entered on this form.

<sup>5</sup> cfs=cubic feet per second.

<sup>6</sup> Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-GRV-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be 03-AUBU-GRV-001.

<sup>7</sup> Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

# Spawning Gravel Abundance Data Collection Form FISH-02

Date: 9/10/03

Measured Flow (cfs): \_\_\_\_\_

Monitoring Team Member Names: DM & K2

Time Measured: \_\_\_\_\_

Stream Segment: Auburn Ravine @ Turkey Creek

Start Point for the Day: 38.89806N/121.26437W

End Point for the Day: 38.89833N/121.25803W

Gravel Bed Identification Number <sup>f</sup>	Gravel Bed Average Length (feet)	Gravel Bed Average Width (feet)	Percentage of Gravel Area in Each Elevation Unit <sup>g</sup>						Gravel Bed Depth (nearest 0.1 foot)	Location (Narrative)/GPS Identification Number/Comments
			-3 to -2 (feet)	-2 to -1 (feet)	-1 to 0 (feet)	0 to +1 (feet)	+1 to +2 (feet)	+2 to +3 (feet)		
03-AUBT-GRV-005	90	25	0	22	53	25	0	0	1.0	N 38.89838° W 121.25999° 374
03-AUBT-GRV-006	66	27	0	6	89	5	0	0	0.9	N 38.89862° W 121.25970°
03-MVB-GRV-007	53	29	0	10	40	60	0	0	0.9	N 38.89862° W 121.25903°
03-AUBT-GRV-008	39	42	0	0	65	35	0	0	0.9	N 38.89844° W 121.25847°

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> cfs=cubic feet per second.

<sup>f</sup> Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-GRV-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be 03-AUBT-GRV-001.

<sup>g</sup> Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

# Spawning Gravel Abundance Data Collection Form FISH-02

Date: 9/16/03

Measured Flow (cfs): \_\_\_\_\_

Monitoring Team Member Names: KZ, DM

Time Measured: \_\_\_\_\_

Stream Segment: Auburn Ravine @ Turkey Creek

Start Point for the Day: 38.89806N/121.26437W

End Point for the Day: 38.89833N/121.25803W

Gravel Bed Identification Number <sup>1</sup>	Gravel Bed Average Length (feet)	Gravel Bed Average Width (feet)	Percentage of Gravel Area in Each Elevation Unit <sup>2</sup>						Gravel Bed Depth (nearest 0.1 foot)	Location (Narrative)/GPS Identification Number/Comments
			-3 to -2 (feet)	-2 to -1 (feet)	-1 to 0 (feet)	0 to +1 (feet)	+1 to +2 (feet)	+2 to +3 (feet)		
<del>03-AUBT-GRV-009</del>	<del>29</del>	<del>32</del>	<del>33</del>	<del>4</del>	<del>48</del>	<del>45</del>	<del>0</del>	<del>0</del>	<del>0.9</del>	<del>38.89833N/121.25803W</del>
<del>03-AUBF-GRV-001</del>	<del>121</del>	<del>27</del>	<del>7</del>	<del>9</del>	<del>40</del>	<del>44</del>	<del>0</del>	<del>0</del>	<del>1.0</del>	<del>38.89841N/121.21808W</del>
<del>03-AUBF-GRV-002</del>	<del>95</del>	<del>32</del>	<del>10</del>	<del>18</del>	<del>54</del>	<del>18</del>	<del>0</del>	<del>0</del>	<del>1.0</del>	<del>38.89207N/121.21756W</del>
<del>03-AUBF-GRV-003</del>	<del>56</del>	<del>31</del>	<del>2</del>	<del>8</del>	<del>40</del>	<del>50</del>	<del>0</del>	<del>0</del>	<del>1.0</del>	<del>38.89256N/121.21704W</del>

<sup>1</sup> List first initial and last name of each member of the monitoring team.

<sup>2</sup> Indicate stream reach.

<sup>3</sup> Geographic location of start point for data entered on this form.

<sup>4</sup> Geographic location of end point for data entered on this form.

<sup>5</sup> cfs=cubic feet per second.

<sup>6</sup> Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-GRV-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be 03-AUBU-GRV-001.

<sup>7</sup> Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

03-AUBF-GRV-004 117 44 0 3 47 28 2 0 1.0 38.89297N/121.21647W

## Page 1 of 3

Category	Average Size [millimeter (inches)]
1	<2 (<0.08)
2	2-5 (0.08-0.2)
3	5-25 (0.2-1)
4	25-102 (1-4)
5	102-152 (4-6)

Modified from Crouse et al. 1981.

- FISH-03**



# Spawning Gravel Quality Data Collection Form FISH-03

Date: 9/10/03

Monitoring Team Member Names: KZ, DM

Stream Segment: Auburn Prairie @ Turkey Creek

Start Point for the Day: 38.89806N/121.26437W

End Point for the Day: 38.89833N/121.25803W

Numeric Categories of Substrate Particle Size <sup>1</sup>	
Category	Average Size (millimeter (inches))
1	<2 (<0.08)
2	2-5 (0.08-0.2)
3	5-25 (0.2-1)
4	25-102 (1-4)
5	102-152 (4-6)

Modified from Crouse et al. 1981.

Gravel Bed Identification Number		Particle Size <sup>1</sup> (millimeters)					Comments/Ground-Level Digital Image Number
		Category 1 ≤2	Category 2 2-5	Category 3 5-25	Category 4 25-102	Category 5 102-150	
03-AUBT-GRM-009	Tally <sup>2</sup>	## 111	## 111	## 111	## 111	1	photo 20
03-AUBT-GRM-001	Tally <sup>2</sup>	## 5	## 35	## 33	## 15		photo 19
03-AUBT-GRM-002	Tally <sup>2</sup>	## 7	## 29	## 33	## 29		photo 18
03-AUBT-GRM-003	Tally <sup>2</sup>	## 11	## 11	## 11	## 11	11	photo 17
03-AUBT-GRM-003	Tally <sup>2</sup>	## 1	## 1	## 1	## 1	2	

- List first initial and last name of each member of the monitoring team.
- Indicate stream reach.
- Geographic location of start point for data entered on this form.
- Geographic location of end point for data entered on this form.
- Use gravel bed identification number from the Spawning Gravel Abundance Data Collection Form FISH-02.
- Keep a tally for each category and then sum the totals.
- Total of particles within category.
- Particle size: see table at top right corner.

Page 1 of 1

Channel Width: 44.0'

WATER-04

# Spawning Gravel Abundance Data Collection Form FISH-02

Date: 9/10/03

Measured Flow (cfs):

Monitoring Team Member Names: KZ, DM

Time Measured:

Stream Segment: Auburn Ravine @ Fork 1 Rd.

Start Point for the Day: 38.89256N/121.21813W

End Point for the Day: 38.89385N/121.21576W

Gravel Bed Identification Number <sup>1</sup>	Gravel Bed Average Length (feet)	Gravel Bed Average Width (feet)	Percentage of Gravel Area in Each Elevation Unit <sup>5</sup>						Gravel Bed Depth (nearest 0.1 foot)	Location (Narrative)/GPS Identification Number/Comments
			-3 to -2 (feet)	-2 to -1 (feet)	-1 to 0 (feet)	0 to +1 (feet)	+1 to +2 (feet)	+2 to +3 (feet)		
03-AUBF-GRV-001	101	27	7	9	40	44	—	—	1.0	38.89241N/121.21802W
03-AUBF-GRV-002	95	32	10	18	54	18	—	—	1.0	38.89207N/121.21756W
03-AUBF-GRV-003	56	31	2	8	40	50	—	—	1.0	38.89256N/121.21704W
03-AUBF-GRV-004	117	44	0	3	47	48	2	0	1.0	38.89297N/121.21647W

<sup>1</sup> List first initial and last name of each member of the monitoring team.

<sup>2</sup> Indicate stream reach.

<sup>3</sup> Geographic location of start point for data entered on this form.

<sup>4</sup> Geographic location of end point for data entered on this form.

<sup>5</sup> cfs=cubic feet per second.

<sup>6</sup> Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-GRV-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be 03-AUBU-GRV-001.

<sup>7</sup> Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

# Spawning Gravel Quality Data Collection Form FISH-03

Date: 9/10/03

Monitoring Team Member Names: K. Zelle, D. Mavacalla

Stream Segment: Aburn Ravine @ Fowler Rd.

Start Point for the Day: 38.89256N/121.21813W

End Point for the Day: 38.89385N/121.21576W

Numeric Categories of Substrate Particle Size <sup>1</sup>	
Category	Average Size (millimeter (inches))
1	<2 (<0.08)
2	2-5 (0.08-0.2)
3	5-25 (0.2-1)
4	25-102 (1-4)
5	102-152 (4-6)

Modified from Crouse et al. 1981.

Gravel Bed Identification Number <sup>e</sup>		Particle Size <sup>f</sup> (millimeters)					Comments/Ground-Level Digital Image Number
		Category 1 ≤2	Category 2 2-5	Category 3 5-25	Category 4 25-102	Category 5 102-150	
03-AUBF-GRN-001	Tally <sup>g</sup>						
	Sheet						
		5	35	33	15		Photo 19
03-AUBF-GRN-002	Tally <sup>g</sup>						
	Sheet						
		7	29	33	29		Photo 18
03-AUBF-GRN-003	Tally <sup>g</sup>						
	Sheet						
		7	47	16	14	2	Photo 17
03-AUBF-GRN-004	Tally <sup>g</sup>						
	Sheet						
		3	45	21	21	8	Photo 16

- <sup>a</sup> List first initial and last name of each member of the monitoring team.
- <sup>b</sup> Indicate stream reach.
- <sup>c</sup> Geographic location of start point for data entered on this form.
- <sup>d</sup> Geographic location of end point for data entered on this form.
- <sup>e</sup> Use gravel bed identification number from the Spawning Gravel Abundance Data Collection Form FISH-02.
- <sup>f</sup> Keep a tally for each category and then sum the totals.
- <sup>g</sup> Total of particles within category.
- <sup>h</sup> Particle size: see table at top right corner.

Photo 16

# Stream Flow Measurements Data Collection Form WATER-01

Page 1 of 1

8:44

Date: 9/4/03

Monitoring Team Member Names\*: R. Zielke,

D. Maniscalco

General Description of Measurement Site  
(stream characteristics and location): Memorial  
Park in Lincoln

Stream Segment<sup>b</sup>: Arbourn Ravine (Memorial Park)

GPS Identification Number<sup>c</sup>: 38.88819N/71.28473W

Channel Width: 30'

Notes on Upstream Changes in Flow  
(i.e., water observed entering or leaving the river):  
Faster water above & below channel  
narrower

Tape Distance (feet) <sup>d</sup>	Depth (feet)	Velocity (feet per second) <sup>e</sup>			Comments
		0.2 * depth	0.8 * depth	0.6 * depth	
2	0.5			.16	
3	0.6			.24	
4	0.7			.44	
5	0.7			.54	
6	0.82			.70	
7	1			.70	
8	1.1			.87	
9	1.2			.76	
10	1.2			.85	
11	1.1			.94	
12	1.1			1.09	
13	1.1			1.13	
14	1.2			.74	
15	1.2			.66	
16	1			.64	
17	1			.67	
18	1.15			.65	
19	1.1			.80	
20	1.1			.84	
21	1.1			.80	
22	1.1			.81	
23	1.1			.85	
24	1.1			.75	
25	1.1			.78	
26	1			.73	

\* List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> The GPS receiver generates an identification number for each collected point. This identification number consists of the GPS receiver identification letter, date, Greenwich Mean Time (GMT), and a letter for multiple points collected within the hour. For example, the GPS identification number A103117C is defined as follows: "A" is the GPS receiver identification letter, "1031" is October 31, "17" is 5 p.m. GMT, and "C" indicates that this point was the third point taken within the 17<sup>th</sup> hour.

<sup>d</sup> The 0 should be at the left water's edge. Left is relative to a person facing downstream.

<sup>e</sup> If depth is greater than 2.5 feet, measure velocity at 0.2 and 0.8 of the total depth. Otherwise, measure velocity at 0.6 of the total depth.

29 1/2

27

28

29

1

1

0.9

.87

.83

.71

# Spawning Gravel Abundance Data Collection Form FISH-02

Page 1 of 6

Date: 9/4/03 Measured Flow (cfs): \_\_\_\_\_  
Monitoring Team Member Names: D. M. K. Z. Time Measured: \_\_\_\_\_  
Stream Segment: Auburn Ravine (Men. Park) - started @ 10:22  
Start Point for the Day: 88319N/121.29701W - start @ small dam w/ water height gauge - Photo # 14  
End Point for the Day: 38.89443N/121.27761W

Gravel Bed Identification Number <sup>f</sup>	Gravel Bed Average Length (feet)	Gravel Bed Average Width (feet)	Percentage of Gravel Area in Each Elevation Unit <sup>g</sup>					Gravel Bed Depth (nearest 0.1 foot)	Location (Narrative)/GPS Identification Number/Comments	
			-3 to -2 (feet)	-2 to -1 (feet)	-1 to 0 (feet)	0 to +1 (feet)	+1 to +2 (feet)	+2 to +3 (feet)		
03-AUB1- GRAV-001	42.5	28.5	5	13	70	12	0	0	0.7	N. 88.8327° W. 121.29701° photo #13
03-AUB1- GRAV-002	52	27	10	20	60	10	0	0	0.3	N. 88.83310° W. 121.29596° photo #11
03-AUB1- GRAV-003	76	30	3	6	39	50	2	0	0.7	N. 88.88287° W. 121.29459° photo #9
03-AUB1- GRAV-004	137	29	1	2	94.5	7	.5	0	0.8	N. 88.88287° W. 121.29412° photo #6

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> cfs=cubic feet per second.

<sup>f</sup> Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-GRAV-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be 03-AUB1-GRAV-001.

<sup>g</sup> Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

# Spawning Gravel Abundance Data Collection Form FISH-02

Page 2 of 6

Date: 9/4/03

Monitoring Team Member Names<sup>a</sup>: DMK2

Stream Segment<sup>b</sup>: Auburn Ravine

Start Point for the Day<sup>c</sup>: 38.88319N/121.29701W

End Point for the Day<sup>d</sup>: 38.89443N/121.29761W

Measured Flow (cfs)<sup>e</sup>: \_\_\_\_\_

Time Measured: \_\_\_\_\_

Gravel Bed Identification Number <sup>f</sup>	Gravel Bed Average Length (feet)	Gravel Bed Average Width (feet)	Percentage of Gravel Area in Each Elevation Unit <sup>g</sup>						Gravel Bed Depth (nearest 0.1 foot)	Location (Narrative)/GPS Identification Number/Comments
			-3 to -2 (feet)	-2 to -1 (feet)	-1 to 0 (feet)	0 to +1 (feet)	+1 to +2 (feet)	+2 to +3 (feet)		
03-AUB1-GRAY-005	57	29	8	20	69	8	4	1	1.8	N 38.88295° W 121.28944°
03-AUB1-GRAY-006	97	35	0	2	98	0	0	0	1.8	N 38.88295° W 121.28944°
03-AUB1-GRAY-007	59	25	5	1	78.5	20	0	0	1.4	N 38.88295° W 121.28944°
03-AUB1-GRAY-008	217	28	0	0	90	4	0	0	1.4	N 38.88295° W 121.28944°

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> cfs=cubic feet per second.

<sup>f</sup> Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-GRAY-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be 03-AUBU-GRAY-001.

<sup>g</sup> Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

# Spawning Gravel Abundance Data Collection Form FISH-02

Date: 9/4/03 Measured Flow (cfs): \_\_\_\_\_  
 Monitoring Team Member Names: DM & Z Time Measured: \_\_\_\_\_  
 Stream Segment: Auburn Ravine (Mem. Park)  
 Start Point for the Day: 38.88319 N / 121.29701 W  
 End Point for the Day: 38.89443 N / 121.27761 W

Gravel Bed Identification Number <sup>f</sup>	Gravel Bed Average Length (feet)	Gravel Bed Average Width (feet)	Percentage of Gravel Area in Each Elevation Unit <sup>g</sup>					Gravel Bed Depth (nearest 0.1 foot)	Location (Narrative)/GPS Identification Number/Comments	GPS MARK
			-3 to -2 (feet)	-2 to -1 (feet)	-1 to 0 (feet)	0 to +1 (feet)	+1 to +2 (feet)	+2 to +3 (feet)		
03-AUB31-GRV-009	57	23	0	2	96	2	0	0	N 38.88482° W 121.28591° photo 23	GPS MARK 224
03-AUB31-GRV-010	75	31	0	3	90	5	0	0	N 38.88482° W 121.28591° photo 21	GPS MARK 225
03-AUB31-GRV-011	74	34	1	8	36	10	1	0	N 38.88482° W 121.28591° photo 19	GPS MARK 226
03-AUB31-GRV-012	68	24			41.5	9	0	0	N 38.88482° W 121.28591° photo 17	GPS MARK 227

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> cfs=cubic feet per second.

<sup>f</sup> Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-GRV-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be -03-AUBU-GRV-001.

<sup>g</sup> Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

# Spawning Gravel Abundance Data Collection Form FISH-02

Date: 9/5/03  
 Monitoring Team Member Names<sup>a</sup>: K.Z., D.M.  
 Stream Segment<sup>b</sup>: Auburn Ravine (New)  
 Start Point for the Day<sup>c</sup>: 38.88787N 121.28493W  
 End Point for the Day<sup>d</sup>: 38.89443N 121.27761W

Measured Flow (cfs)<sup>e</sup>: \_\_\_\_\_  
 Time Measured: \_\_\_\_\_

Gravel Bed Identification Number <sup>f</sup>	Gravel Bed Average Length (feet)	Gravel Bed Average Width (feet)	Percentage of Gravel Area in Each Elevation Unit <sup>g</sup>					Gravel Bed Depth (nearest 0.1 foot)	Location (Narrative)/GPS Identification Number/Comments	Mark
			-3 to -2 (feet)	-2 to -1 (feet)	-1 to 0 (feet)	0 to +1 (feet)	+1 to +2 (feet)	+2 to +3 (feet)		
03-AUB1-GRAB-013	46	29	10	15	30	45	0	0	38.88787N/121.28493W photo 15	228
03-AUB1-GRAB-014	88	23	15	35	35	15	0	0	38.88840N / 121.28431W photo 13	230
03-AUB1-GRAB-015	117	37	20	3	47	50	0	0	38.88830N / 121.28440W photo 11	230
03-AUB1-GRAB-016	127	26	7	67	30	1	1	0	38.88944N / 121.27761W photo 9	231

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> cfs=cubic feet per second.

<sup>f</sup> Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-GRAB-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be 03-AUB1-GRAB-001.

<sup>g</sup> Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

# Spawning Gravel Abundance Data Collection Form FISH-02

Date: 9/5/03 Measured Flow (cfs): \_\_\_\_\_  
Monitoring Team Member Names: DM K2 Time Measured: \_\_\_\_\_  
Stream Segment: Auburn Ravine (Ment)

Start Point for the Day: 38.8878N, 121.28493 W  
End Point for the Day: 38.89443N/121.27761W

Gravel Bed Identification Number <sup>f</sup>	Gravel Bed Average Length (feet)	Gravel Bed Average Width (feet)	Percentage of Gravel Area in Each Elevation Unit <sup>g</sup>					Gravel Bed Depth (nearest 0.1 foot)	Location (Narrative)/GPS Identification Number/Comments	GPS Work
			-3 to -2 (feet)	-2 to -1 (feet)	-1 to 0 (feet)	0 to +1 (feet)	+1 to +2 (feet)	+2 to +3 (feet)		
03-AUB1-GRAB-017	27	30	0	0	0	38	0	0	N 38.88944 W 121.28278 photo 7	238
03-AUB4-GRAB-018	187	32	9	15	40	35	1	0	N 38.89157 W 121.28112 photo 1	238
03-AUB4-GRAB-019	40	31	3	7	80	10	0	0	N 38.89246 W 121.28143 photo	235
03-AUB1-GRAB-020	37	21	0	3	62	35	0	0	N 38.89326 W 121.28076 photo	236

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> cfs=cubic feet per second.

<sup>f</sup> Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-GRAB-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be 03-AUBU-GRAB-001.

<sup>g</sup> Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

# Spawning Gravel Abundance Data Collection Form FISH-02

Date: Sept. 5, 2003

Measured Flow (cfs): \_\_\_\_\_

Monitoring Team Member Names: DM & K2

Time Measured: \_\_\_\_\_

Stream Segment: Auburn Ravine (Memphard Park)

Start Point for the Day: 38.88319N/121.29701W

End Point for the Day: 38.89443N/121.27761W

Gravel Bed Identification Number <sup>f</sup>	Gravel Bed Average Length (feet)	Gravel Bed Average Width (feet)	Percentage of Gravel Area in Each Elevation Unit <sup>g</sup>						Gravel Bed Depth (nearest 0.1 foot)	Location (Narrative)/GPS Identification Number/Comments	
			-3 to -2 (feet)	-2 to -1 (feet)	-1 to 0 (feet)	0 to +1 (feet)	+1 to +2 (feet)	+2 to +3 (feet)			
03-AUB1- GRAV-021	59	33	0	4	59	25	9	3	1.0	N38.89341° W121.28653° photo	237
03-AUB1- GRAV-022	58	27	0	3	52	45	0	0	0.9	N38.89378° W121.27883° photo	238
03-AUB1- GRAV-013	75	33	15	20	15	50	0	0	0.8	N38.89443° W121.27761° photo	239

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> cfs=cubic feet per second.

<sup>f</sup> Number gravel beds sequentially for each water year using the following naming convention: "WY-Stream Name-GRAV-Bed#", where "WY" is the last 2 digits of the water year (e.g., 01 for 2001), "Stream Name" is the first four letters of the stream name, and "Bed#" is a 3-digit bed number (e.g., 001 for first location and 002 for second location). For example, the first gravel bed in water year 2003 on Auburn Ravine would be 03-AUBU-GRAV-001.

<sup>g</sup> Elevational units are relative to the water surface and describe the depth of the water covering the spawning gravel in 1-foot increments. Negative numbers designate elevational units below the water surface, positive numbers designate elevational units above the water surface, and 0 is the water surface.

Date: 9/4/03

Monitoring Team Member Names<sup>a</sup>: K. Z. DM

Stream Segment<sup>b</sup>: AVBORN RAVINE - Memorial Park

Start Point for the Day: 388839N/12129761W

End Point for the Day: 38.89443N/121.27761W

Category	Average Size [millimeter (inches)]
1	<2 (<0.08)
2	2-5 (0.08-0.2)
3	5-25 (0.2-1)
4	25-102 (1-4)
5	102-152 (4-6)

Modified from Crouse et al. 1981.

Gravel Bed Identification Number <sup>e</sup>	Particle Size <sup>f</sup> (millimeters)					Comments/Ground-Level Digital Image Number
	Category 1 ≤2 35	Category 2 2-5 12	Category 3 5-25 13	Category 4 25-102	Category 5 102-150	
03-AUB1- GRAV-001	Tally <sup>g</sup> Sum <sup>h</sup>	Tally <sup>g</sup> Sum <sup>h</sup>	Tally <sup>g</sup> Sum <sup>h</sup>	Tally <sup>g</sup> Sum <sup>h</sup>	Tally <sup>g</sup> Sum <sup>h</sup>	Photo #12 - lots of small material
03-AUB1- GRAV-002	Tally <sup>g</sup> Sum <sup>h</sup>	Tally <sup>g</sup> Sum <sup>h</sup>	Tally <sup>g</sup> Sum <sup>h</sup>	Tally <sup>g</sup> Sum <sup>h</sup>	Tally <sup>g</sup> Sum <sup>h</sup>	Photo #10
03-AUB1- GRAV-003	Tally <sup>g</sup> Sum <sup>h</sup>	Tally <sup>g</sup> Sum <sup>h</sup>	Tally <sup>g</sup> Sum <sup>h</sup>	Tally <sup>g</sup> Sum <sup>h</sup>	Tally <sup>g</sup> Sum <sup>h</sup>	Photo #8
03-AUB1- GRAV-004	Tally <sup>g</sup> Sum <sup>h</sup>	Tally <sup>g</sup> Sum <sup>h</sup>	Tally <sup>g</sup> Sum <sup>h</sup>	Tally <sup>g</sup> Sum <sup>h</sup>	Tally <sup>g</sup> Sum <sup>h</sup>	Photo #87

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.<sup>d</sup> Geographic location of end point for data entered on this form.

Use gravel bed identification number from the Spawning Gravel Abundance Data Collection Form FISH-02.

Keep a tally for each category and then sum the totals.

<sup>3</sup> Total of particles within category.

<sup>17</sup> Particle size: see table at top right corner.

Monitoring Team Member Names<sup>a</sup>: KZ: DM

Start Point for the Day: 38.8839N/121.2970W

End Point for the Day<sup>d</sup>: 38.89443N/121.2776W

Modified from Crouse et al. 1981.

Gravel Bed Identification Number <sup>e</sup>	Particle Size <sup>f</sup> (millimeters)					Comments/Ground-Level Digital Image Number
	Category 1 ≤2	Category 2 2-5	Category 3 5-25	Category 4 25-102	Category 5 102-150	
03-AUB1- GRAY-005	Tally <sup>g</sup>   					

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.<sup>d</sup> Geographic location of end point for data entered on this form.

Use gravel bed identification number from the Spawning Gravel Abundance Data Collection Form FISH-02.

Keep a tally for each category and then sum the totals.

<sup>§</sup> Total of particles within category.

<sup>h</sup> Particle size: see table at top right corner.

# Spawning Gravel Quality Data Collection Form FISH-03

Date: 9/4/03

Monitoring Team Member Names: K. E. D. M.

Stream Segment:

Start Point for the Day: 38.88319N/121.29701W

End Point for the Day: 38.89443N/121.27761W

Numeric Categories of Substrate Particle Size <sup>f</sup>	
Category	Average Size [millimeter (inches)]
1	<2 (<0.08)
2	2-5 (0.08-0.2)
3	5-25 (0.2-1)
4	25-102 (1-4)
5	102-152 (4-6)

Modified from Crouse et al. 1981.

Gravel Bed Identification Number <sup>e</sup>	Particle Size <sup>f</sup> (millimeters)					Comments/Ground-Level Digital Image Number
	Category 1 ≤2	Category 2 2-5	Category 3 5-25	Category 4 25-102	Category 5 102-150	
03-AUB1- GRAV-009	Tally <sup>g</sup>       Sum <sup>h</sup> 30	 13	 20	 26		photo 24
03-AUB1- GRAV-010	Tally <sup>g</sup>       Sum <sup>h</sup> 28	 19	 27	 15		photo 22
03-AUB1- GRAV-011	Tally <sup>g</sup>       Sum <sup>h</sup> 43	 25	 10	 11		photo 20
03-AUB1- GRAV-012	Tally <sup>g</sup>       Sum <sup>h</sup> 25	 20	 15	 24		photo 18

<sup>a</sup> List first initial and last name of each member of the monitoring team.

<sup>b</sup> Indicate stream reach.

<sup>c</sup> Geographic location of start point for data entered on this form.

<sup>d</sup> Geographic location of end point for data entered on this form.

<sup>e</sup> Use gravel bed identification number from the Spawning Gravel Abundance Data Collection Form FISH-02.

<sup>f</sup> Keep a tally for each category and then sum the totals.

<sup>g</sup> Total of particles within category.

<sup>h</sup> Particle size: see table at top right corner.

# Spawning Gravel Quality Data Collection Form FISH-03

Start @ 8:20

Date: 9/5/03  
 Monitoring Team Member Names: KZ, DM  
 Stream Segment: Auburn Ravine (Memorial Park)  
 Start Point for the Day: 38.88787N/121.28493W (2nd day start point)  
 End Point for the Day: 38.89443N/121.27761W

Numeric Categories of Substrate Particle Size <sup>f</sup>	
Category	Average Size [millimeter (inches)]
1	<2 (<0.08)
2	2-5 (0.08-0.2)
3	5-25 (0.2-1)
4	25-102 (1-4)
5	102-152 (4-6)

Modified from Crouse et al. 1981.

Gravel Bed Identification Number <sup>e</sup>	Particle Size <sup>f</sup> (millimeters)					Comments/Ground-Level Digital Image Number
	Category 1 ≤2	Category 2 2-5	Category 3 5-25	Category 4 25-102	Category 5 102-150	
03-AUG 1- GRAV-013	Tally <sup>g</sup>                         49	             17	             14	             8		photo 16
03-AUG 2- GRAV-014	Tally <sup>g</sup>                   242	             17	             17	             13		photo 14
03-AUG 2- GRAV-015	Tally <sup>g</sup>                   21	             19	             27	             20		photo 12
03-AUG 2- GRAV-016	Tally <sup>g</sup>                   10	             28	             34	             12		photo 10
	Sum <sup>h</sup>					

<sup>a</sup> List first initial and last name of each member of the monitoring team.  
<sup>b</sup> Indicate stream reach.  
<sup>c</sup> Geographic location of start point for data entered on this form.  
<sup>d</sup> Geographic location of end point for data entered on this form.  
<sup>e</sup> Use gravel bed identification number from the Spawning Gravel Abundance Data Collection Form FISH-02.  
<sup>f</sup> Keep a tally for each category and then sum the totals.  
<sup>g</sup> Total of particles within category.  
<sup>h</sup> Particle size: see table at top right corner.

# Spawning Gravel Quality Data Collection Form FISH-03

Date: 9/5/03

Monitoring Team Member Names: DM, KE

Stream Segment: Auburn Ravine (Memorial Park)

Start Point for the Day: 38.88319N/121.29701W

End Point for the Day: 38.89443N/121.27761W

Numeric Categories of Substrate Particle Size <sup>f</sup>	
Category	Average Size [millimeter (inches)]
1	<2 (<0.08)
2	2-5 (0.08-0.2)
3	5-25 (0.2-1)
4	25-102 (1-4)
5	102-152 (4-6)

Modified from Crouse et al. 1981.

Gravel Bed Identification Number <sup>e</sup>	Tally <sup>g</sup>	Particle Size <sup>f</sup> (millimeters)				Comments/Ground-Level Digital Image Number
		Category 1 ≤2	Category 2 2-5	Category 3 5-25	Category 4 25-102	Category 5 102-150
03-AUB1- GRAV-017	Tally <sup>g</sup> 160					photo 8
03-AUB1- GRAV-018	Tally <sup>g</sup> 8					photo 6
03-AUB1- GRAV-019	Tally <sup>g</sup> 2					photo 5
03-AUB1- GRAV-020	Tally <sup>g</sup> 10					photo 4

<sup>a</sup> List first initial and last name of each member of the monitoring team.<sup>b</sup> Indicate stream reach.<sup>c</sup> Geographic location of start point for data entered on this form.<sup>d</sup> Geographic location of end point for data entered on this form.<sup>e</sup> Use gravel bed identification number from the Spawning Gravel Abundance Data Collection Form FISH-02.<sup>f</sup> Keep a tally for each category and then sum the totals.<sup>g</sup> Total of particles within category.<sup>h</sup> Particle size: see table at top right corner.

Appendix C

## **Spawning Gravel Data**

Creek	Date	Gravel Bed ID Number	Average Length (feet)	Average Width (feet)	Elevation -3 to -2 (%)	Elevation -2 to -1 (%)	Elevation -1 to 0 (%)	Elevation 0 to 1 (%)	Elevation 1 to 2 (%)	Elevation 2 to 3 (%)	Gravel Bed Depth (feet)	Square Feet	Tot. Sq. Ft.
Secret Ravine	8/5/03	03-SECR-GRAV-001	27.5	11.6			95	5			0.8	319.00	
Secret Ravine	8/5/03	03-SECR-GRAV-002	48.2	11.3			90	10			0.7	544.66	
Secret Ravine	8/5/03	03-SECR-GRAV-003	26.5	9.5			20	80			0.7	251.75	
Secret Ravine	8/5/03	03-SECR-GRAV-004	7.5	8.2			100				0.7	61.50	1176.91
Antelope Creek	8/6/03	03-ANTE-GRAV-001	16.5	12.9			40	40	20		1	212.85	212.85
Miner's Ravine (Preserve)	8/6/03	03-MRNP-GRAV-001	45.5	7			90	10			1	318.50	
Miner's Ravine (Preserve)	8/6/03	03-MRNP-GRAV-002	21.1	9.3			99	1			1	196.23	514.73
Miner's Ravine (main)	8/7/03	03-MINEM-GRAV-001	12	9		100					0.6	108.00	108.00
Doty Ravine	8/11/03	03-DOTY-GRAV-001	12	7			100				0.7	84.00	
Doty Ravine	8/11/03	03-DOTY-GRAV-002	42	10.5			95	5			0.8	441.00	
Doty Ravine	8/11/03	03-DOTY-GRAV-003	28	11			100				0.9	308.00	833.00
Coon Creek	8/14/03	03-COON-GRAV-001	71	6			100				0.6	426.00	426.00
Doty Ravine (Crosby)	8/15/03	03-DOTC-GRAV-001	89.2	15		20	40	40			0.6	1338.00	
Doty Ravine (Crosby)	8/15/03	03-DOTC-GRAV-002	39.5	20.5				100			0.5	809.75	2147.75
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-001	42.5	28.5	5	13	70	12	0	0	0.7	1211.25	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-002	52	27	10	20	60	10	0	0	0.8	1404.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-003	76	30	3	6	39	50	2	0	0.7	2280.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-004	137	29	1	2	94.5	2	0.5	0	0.8	3973.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-005	57	29	8	20	69	8	4	1	0.8	1653.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-006	91	35	0	2	98	0	0	0	0.8	3185.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-007	59	25	0.5	1	78.5	20	0	0	1	1475.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-008	217	28	0	0	96	4	0	0	1	6076.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-009	74	23	0	2	96	2	0	0	1	1702.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-010	75	31	0	5	90	5	0	0	1	2325.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-011	74	34	1	3	86	10	0	0	0.8	2516.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-012	68	27	0	0	99.5	0.5	0	0	0.8	1836.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-013	46	29	10	15	30	45	0	0	0.7	1334.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-014	88	23	15	35	35	15	0	0	0.7	2024.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-015	117	37	0	3	47	50	0	0	1	4329.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-016	127	26	7	61	30	1	1	0	0.8	3302.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-017	27	30	0	0	62	38	0	0	0.6	810.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-018	187	32	9	15	40	35	1	0	0.8	5984.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-019	40	31	3	7	80	10	0	0	1	1240.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-020	37	21	0	3	62	35	0	0	0.8	777.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-021	59	33	0	4	59	25	9	3	1	1947.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-022	58	27	0	3	52	45	0	0	0.9	1566.00	
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-023	75	33	15	20	15	50	0	0	0.8	2475.00	55424.25
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-001	177	29	3	6	45	45	1	0	1	5133.00	
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-002	70	25	7	13	45	35	0	0	0.8	1750.00	
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-003	138	27	0	5	90	5	0	0	0.8	3726.00	
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-004	73	33	2	6	52	40	0	0	1	2409.00	
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-005	90	25	0	22	53	25	0	0	1	2250.00	
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-006	66	27	0	6	89	5	0	0	0.9	1782.00	
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-007	53	29	0	10	40	60	0	0	0.9	1537.00	
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-008	39	42	0	0	65	35	0	0	0.9	1638.00	
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-009	29	32	3	4	48	45	0	0	0.9	928.00	21153.00
Auburn Ravine (Fowler Rd.)	9/10/03	03-AUBF-GRAV-001	101	27	7	9	40	44	0	0	1	2727.00	
Auburn Ravine (Fowler Rd.)	9/10/03	03-AUBF-GRAV-002	95	32	10	18	54	18	0	0	1	3040.00	
Auburn Ravine (Fowler Rd.)	9/10/03	03-AUBF-GRAV-003	56	31	2	8	40	50	0	0	1	1736.00	
Auburn Ravine (Fowler Rd.)	9/10/03	03-AUBF-GRAV-004	117	44	0	3	47	48	2	0	1	5148.00	12651.00

89228.25

94647.49

Creek	Date	Gravel Bed ID Number	Category 1 <2mm(sum)	Category 2 2-5(sum)	Category 3 5-25(sum)	Category 4 25-102(sum)	Category 5 102-152(sum)	Sum of p <5mm	Sum of Particles 5-152mm						
Secret Ravine	8/5/03	03-SECR-GRAV-001	48	52.17%	28	30.43%	12	13.04%	4	4.35%	0	0.00%	82.61%	17.39%	92
Secret Ravine	8/5/03	03-SECR-GRAV-002	23	25.84%	22	24.72%	12	13.48%	27	30.34%	5	5.62%	50.56%	49.44%	89
Secret Ravine	8/5/03	03-SECR-GRAV-003	40	46.51%	18	20.93%	13	15.12%	15	17.44%	0	0.00%	67.44%	32.56%	86
Secret Ravine	8/5/03	03-SECR-GRAV-004	49	55.68%	19	21.59%	8	9.09%	12	13.64%	0	0.00%	77.27%	22.73%	88
Antelope Creek	8/6/03	03-ANTE-GRAV-001	47	49.47%	27	28.42%	13	13.68%	3	3.16%	5	5.26%	77.89%	22.11%	95
Miner's Ravine (Preserve)	8/6/03	03-MRNP-GRAV-001	38	42.22%	24	26.67%	24	26.67%	4	4.44%	0	0.00%	68.89%	31.11%	90
Miner's Ravine (Preserve)	8/6/03	03-MRNP-GRAV-002	45	47.87%	25	26.60%	21	22.34%	3	3.19%	0	0.00%	74.47%	25.53%	94
Miner's Ravine (Main)	8/7/03	03-MINEM-GRAV-001	28	31.82%	16	18.18%	30	34.09%	14	15.91%	0	0.00%	50.00%	50.00%	88
Doty Ravine	8/11/03	03-DOTY-GRAV-001	35	37.63%	19	20.43%	29	31.18%	10	10.75%	0	0.00%	58.06%	41.94%	93
Doty Ravine	8/11/03	03-DOTY-GRAV-002	32	35.96%	26	29.21%	30	33.71%	1	1.12%	0	0.00%	65.17%	34.83%	89
Doty Ravine	8/11/03	03-DOTY-GRAV-003	18	19.57%	30	32.61%	41	44.57%	3	3.26%	0	0.00%	52.17%	47.83%	92
Coon Creek	8/14/03	03-COON-GRAV-001	22	24.44%	29	32.22%	33	36.67%	6	6.67%	0	0.00%	56.67%	43.33%	90
Doty Ravine (Crosby)	8/15/03	03-DOTC-GRAV-001	35	39.77%	21	23.86%	14	15.91%	18	20.45%	0	0.00%	63.64%	36.36%	88
Doty Ravine (Crosby)	8/15/03	03-DOTC-GRAV-002	38	43.68%	27	31.03%	22	25.29%	0	0.00%	0	0.00%	74.71%	25.29%	87
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-001	52	61.18%	16	18.82%	15	17.65%	2	2.35%	0	0.00%	80.00%	20.00%	85
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-002	51	59.30%	11	12.79%	15	17.44%	9	10.47%	0	0.00%	72.09%	27.91%	86
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-003	35	39.33%	36	40.45%	15	16.85%	3	3.37%	0	0.00%	79.78%	20.22%	89
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-004	27	31.76%	13	15.29%	20	23.53%	25	29.41%	0	0.00%	47.06%	52.94%	85
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-005	42	47.19%	22	24.72%	20	22.47%	5	5.62%	0	0.00%	71.91%	28.09%	89
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-006	32	34.78%	26	28.26%	27	29.35%	7	7.61%	0	0.00%	63.04%	36.96%	92
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-007	28	33.33%	21	25.00%	23	27.38%	12	14.29%	0	0.00%	58.33%	41.67%	84
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-008	28	32.94%	19	22.35%	27	31.76%	11	12.94%	0	0.00%	55.29%	44.71%	85
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-009	30	33.71%	13	14.61%	20	22.47%	26	29.21%	0	0.00%	48.31%	51.69%	89
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-010	28	31.46%	19	21.35%	27	30.34%	15	16.85%	0	0.00%	52.81%	47.19%	89
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-011	43	48.31%	25	28.09%	10	11.24%	11	12.36%	0	0.00%	76.40%	23.60%	89
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-012	25	29.76%	20	23.81%	15	17.86%	24	28.57%	0	0.00%	53.57%	46.43%	84
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-013	49	55.68%	17	19.32%	14	15.91%	8	9.09%	0	0.00%	75.00%	25.00%	88
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-014	42	47.19%	17	19.10%	17	19.10%	13	14.61%	0	0.00%	66.29%	33.71%	89
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-015	21	24.14%	19	21.84%	27	31.03%	20	22.99%	0	0.00%	45.98%	54.02%	87
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-016	10	11.90%	28	33.33%	34	40.48%	12	14.29%	0	0.00%	45.24%	54.76%	84
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-017	60	65.93%	22	24.18%	6	6.59%	3	3.30%	0	0.00%	90.11%	9.89%	91
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-018	8	9.30%	19	22.09%	34	39.53%	25	29.07%	0	0.00%	31.40%	68.60%	86
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-019	2	2.27%	23	26.14%	51	57.95%	12	13.64%	0	0.00%	28.41%	71.59%	88
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-020	16	18.18%	35	39.77%	22	25.00%	15	17.05%	0	0.00%	57.95%	42.05%	88
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-021	7	7.87%	27	30.34%	38	42.70%	17	19.10%	0	0.00%	38.20%	61.80%	89
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-022	7	8.14%	39	45.35%	23	26.74%	17	19.77%	0	0.00%	53.49%	46.51%	86
Auburn Ravine (Memorial)	9/4/03	03-AUB1-GRAV-023	16	18.60%	39	45.35%	14	16.28%	17	19.77%	0	0.00%	63.95%	36.05%	86
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-001	2	2.22%	36	40.00%	36	40.00%	16	17.78%	0	0.00%	42.22%	57.78%	90
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-002	3	3.57%	65	77.38%	13	15.48%	3	3.57%	0	0.00%	80.95%	19.05%	84
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-003	6	6.82%	35	39.77%	31	35.23%	16	18.18%	0	0.00%	46.59%	53.41%	88
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-004	32	36.36%	33	37.50%	20	22.73%	3	3.41%	0	0.00%	73.86%	26.14%	88
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-005	39	43.33%	26	28.89%	11	12.22%	14	15.56%	0	0.00%	72.22%	27.78%	90
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-006	15	17.24%	35	40.23%	21	24.14%	16	18.39%	0	0.00%	57.47%	42.53%	87
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-007	19	20.88%	43	47.25%	18	19.78%	11	12.09%	0	0.00%	68.13%	31.87%	91
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-008	4	4.65%	31	36.05%	36	41.86%	15	17.44%	0	0.00%	40.70%	59.30%	86
Auburn Ravine (Turkey Cr.)	9/10/03	03-AUBT-GRAV-009	28	31.82%	26	29.55%	23	26.14%	10	11.36%	1	1.14%	61.36%	38.64%	88
Auburn Ravine (Fowler Rd.)	9/10/03	03-AUBF-GRAV-001	5	5.68%	35	39.77%	33	37.50%	15	17.05%	0	0.00%	45.45%	54.55%	88
Auburn Ravine (Fowler Rd.)	9/10/03	03-AUBF-GRAV-002	7	7.14%	29	29.59%	33	33.67%	29	29.59%	0	0.00%	36.73%	63.27%	98
Auburn Ravine (Fowler Rd.)	9/10/03	03-AUBF-GRAV-003	7	8.14%	47	54.65%	16	18.60%	14	16.28%	2	2.33%	62.79%	37.21%	86
Auburn Ravine (Fowler Rd.)	9/10/03	03-AUBF-GRAV-004	3	3.33%	45	50.00%	21	23.33%	21	23.33%	0	0.00%	53.33%	46.67%	90

Creek	Date	Gravel Bed ID Number	GPS		Start Point		End Point	
			(North)	(West)	(North)	(West)	(North)	(West)
Doty Ravine	8/11/03	03-DOTY-GRAV-001	38.93443	121.22839	38.93439	121.22837	38.93050	121.21619
Doty Ravine	8/11/03	03-DOTY-GRAV-002	38.93354	121.22803				
Doty Ravine	8/11/03	03-DOTY-GRAV-003	38.93353	121.22678				
Secret Ravine	8/5/03	03-SECR-GRAV-001	38.79182	121.21588	38.56089	121.47713	38.79175	121.21583
Secret Ravine	8/5/03	03-SECR-GRAV-002	38.79535	121.21162				
Secret Ravine	8/5/03	03-SECR-GRAV-003	38.79737	121.20543				
Secret Ravine	8/5/03	03-SECR-GRAV-004	38.79728	121.29538				
Antelope Creek	8/6/03	03-ANTE-GRAV-001	38.77500	121.25323	38.77500	121.25323	38.79097	121.24950
Miner's Ravine (Preserve)	8/6/03	03-MRNP-GRAV-001	38.75423	121.17030	38.75384	121.17039	38.75755	121.16406
Miner's Ravine (Preserve)	8/6/03	03-MRNP-GRAV-002	38.75439	121.16949				
Miner's Ravine (main)	8/7/03	03-MINEM-GRAV-001	39.75541	121.26701	38.75439	121.16953	38.75628	121.22447
Coon Creek	8/14/03	03-COON-GRAV-001	38.98513	121.26838	38.98379	121.26996	38.98973	121.26543
Doty Ravine (Crosby)	8/15/03	03-DOTC-GRAV-001	38.93995	121.24230	38.93983	121.24669	38.93840	121.23460
Doty Ravine (Crosby)	8/15/03	03-DOTC-GRAV-002	38.93933	121.24230				
Auburn Ravine (Memorial F	9/4/03	03-AUB1-GRAV-001	38.88327	121.29559	38.88319	121.29701	38.89443	121.27761
Auburn Ravine (Memorial F	9/4/03	03-AUB1-GRAV-002	38.88310	121.29526				
Auburn Ravine (Memorial F	9/4/03	03-AUB1-GRAV-003	38.88287	121.29459				
Auburn Ravine (Memorial F	9/4/03	03-AUB1-GRAV-004	38.88287	121.29412				
Auburn Ravine (Memorial F	9/4/03	03-AUB1-GRAV-005	38.88295	121.28944				
Auburn Ravine (Memorial F	9/4/03	03-AUB1-GRAV-006	38.88293	121.28880				
Auburn Ravine (Memorial F	9/4/03	03-AUB1-GRAV-007	38.88346	121.28673				
Auburn Ravine (Memorial F	9/4/03	03-AUB1-GRAV-008	38.88371	121.28645				
Auburn Ravine (Memorial F	9/4/03	03-AUB1-GRAV-009	38.88483	121.28596				
Auburn Ravine (Memorial F	9/4/03	03-AUB1-GRAV-010	38.88609	121.28566				
Auburn Ravine (Memorial F	9/4/03	03-AUB1-GRAV-011	38.88670	121.28575				
Auburn Ravine (Memorial F	9/4/03	03-AUB1-GRAV-012	38.88778	121.28537				
Auburn Ravine (Memorial F	9/5/03	03-AUB1-GRAV-013	38.88787	121.28493				
Auburn Ravine (Memorial F	9/5/03	03-AUB1-GRAV-014	38.88840	121.28431				
Auburn Ravine (Memorial F	9/5/03	03-AUB1-GRAV-015	38.88830	121.28436				
Auburn Ravine (Memorial F	9/5/03	03-AUB1-GRAV-016	38.88924	121.28347				
Auburn Ravine (Memorial F	9/5/03	03-AUB1-GRAV-017	38.88944	121.28278				
Auburn Ravine (Memorial F	9/5/03	03-AUB1-GRAV-018	38.89152	121.28170				
Auburn Ravine (Memorial F	9/5/03	03-AUB1-GRAV-019	38.89246	121.28143				
Auburn Ravine (Memorial F	9/5/03	03-AUB1-GRAV-020	38.89326	121.28075				
Auburn Ravine (Memorial F	9/5/03	03-AUB1-GRAV-021	38.89341	121.28053				
Auburn Ravine (Memorial F	9/5/03	03-AUB1-GRAV-022	38.89378	121.27883				
Auburn Ravine (Memorial F	9/5/03	03-AUB1-GRAV-023	38.89443	121.27761				
Auburn Ravine (Turkey Cre	9/10/03	03-AUBT-GRAV-001	38.89806	121.26437	38.89806	121.26437	38.89833	121.25803
Auburn Ravine (Turkey Cre	9/10/03	03-AUBT-GRAV-002	38.89857	121.26319				
Auburn Ravine (Turkey Cre	9/10/03	03-AUBT-GRAV-003	38.89838	121.26176				
Auburn Ravine (Turkey Cre	9/10/03	03-AUBT-GRAV-004	38.89851	121.26054				
Auburn Ravine (Turkey Cre	9/10/03	03-AUBT-GRAV-005	38.89838	121.25999				
Auburn Ravine (Turkey Cre	9/10/03	03-AUBT-GRAV-006	38.89878	121.25970				
Auburn Ravine (Turkey Cre	9/10/03	03-AUBT-GRAV-007	38.89862	121.25903				
Auburn Ravine (Turkey Cre	9/10/03	03-AUBT-GRAV-008	38.89847	121.25847				
Auburn Ravine (Turkey Cre	9/10/03	03-AUBT-GRAV-009	38.89833	121.25803				
Auburn Ravine (Fowler Rd.	9/10/03	03-AUBF-GRAV-001	38.89241	121.21802	38.89256	121.21813	38.89385	121.21576
Auburn Ravine (Fowler Rd.	9/10/03	03-AUBF-GRAV-002	38.89207	121.21756				
Auburn Ravine (Fowler Rd.	9/10/03	03-AUBF-GRAV-003	38.89256	121.21704				
Auburn Ravine (Fowler Rd.	9/10/03	03-AUBF-GRAV-004	38.89297	121.21647				